Hagenson, I. and
J.F. O'Connor

A Fisheries Inventory of Dogskin, Family, Viking and Vickers Lakes, 1978

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DEPARTMENT OF NATURAL RESOURCES
Fisheries

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A Fisheries Inventory of Dogskin, Family, Viking and Vickers lakes, 1978.

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ABSTRACT

This study was conducted from June 26, 1978 to July 9, 1978 to determine the sport fish potential of the lakes and provide baseline data to permit recommendations for improving recreational fishing opportunities. All the study lakes are eutrophic headwater lakes with potential for high quality recreational fisheries.

Dogskin Lake Lodge has had no major adverse effect on the sport fishing stocks of Dogskin Lake.

The present regulatory policy on Family Lake should be reviewed and a reallocation of the fisheries resource implemented.

The shallow depth and small size of Viking and Vickers lakes' and the integral association of their stocks with upstream and downstream populations limit the opportunities for stock enhancement through any selective stocking or regulatory program.

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INTRODUCTION

Dogskin, Family, Viking and Vickers lakes' are presently accessable only by aircraft or canoe. The isolation of these lakes will eventually change as an expanding transportation network penetrates further into the area east of Lake Winnipeg.

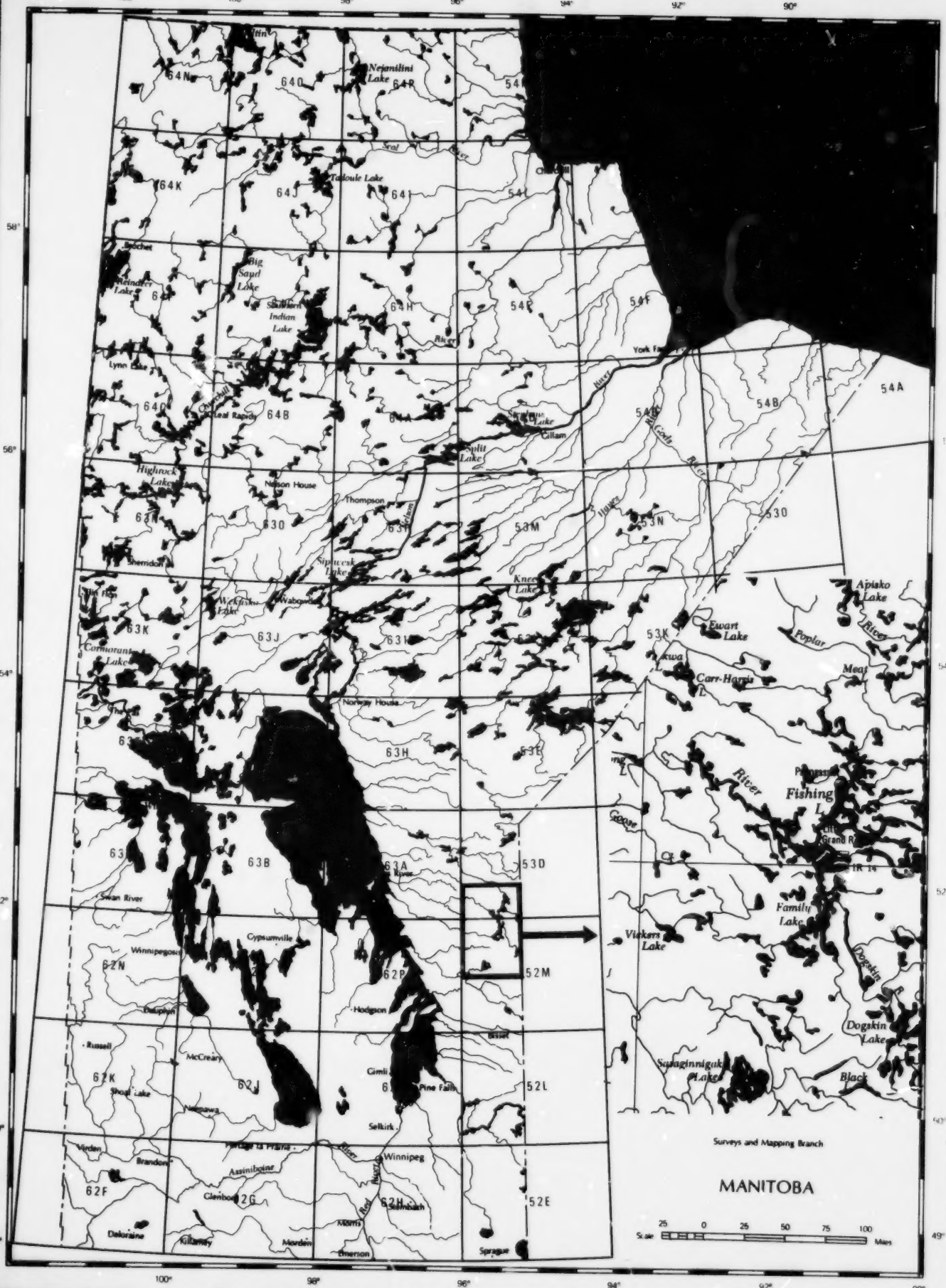
The remo : nature of the lakes ensures fairly light angler pressure. The results of the angling licence questionnaire from 1967 to 1972 show 10.5 percent of resident Manitoba anglers and 11 percent of non-resident anglers venture into the area on the east side of Lake Winnipeg to fish. If the provincial angler distribution has remained unchanged since the surveys, approximately 30,000 anglers fished this area in 1978.

There is no cabin or permanent structure on Vickers Lake. There is an outcamp cabin on Viking Lake. Dogskin and Family lakes both have a fishing lodge. In addition to the 20 bed lodge on Family Lake there is the community of Little Grand Rapids with 622 residents (Carl Wall personal communication).

The objectives of the study were to determine the sport fish potential of the lakes and provide baseline data to permit recommendations, for improving recreational fishing opportunities in the lakes.

The study area

The location of the lakes by latitude (N) and longitude (W) is Dogskin 51^{o} 43' 95^{o} 12', Family 51^{o} 54' 95^{o} 27', Viking 51^{o} 54' 95^{o} 49' and Vickers 51^{o} 52' 95^{o} 54', which is approximately 230 km. northeast of Winnipeg. Dogskin Lake is on the Dogskin River system and Family Lake is a headwater lake of both the Berens and Pigeon Rivers system. Viking and Vickers lakes are on the Pigeon River (Fig. 1).


Surveys and Mapping Branch
MANITOBA
Scale
25 0 25 50 75 100
Miles
Winnipeg
Brandon
Thompson
Norway House
Cross Lake
Gillam
Split Lake
Nelson House
Lynn Lake
Leaf Rapids
Churchill
Ilford
Gypsumville
Dauphin
Russell
McCreary
Swan River
Virden
Assiniboine
Carberry
Portage la Prairie
Selkirk
Gimli
Pine Falls
Hodgson
Beausejour
Sprague
Emerson
Morris
Killarney
Deloraine
Mordern
Snow Lake
Wabowden
Sherridon
Cormorant Lake
Wekusko Lake
Highrock Lake
Big Sand Lake
Setting Lake
Indian Lake
Tadoule Lake
Seal River
Nejanilini Lake
Knee Lake
Ilford
Ilford
Ilford

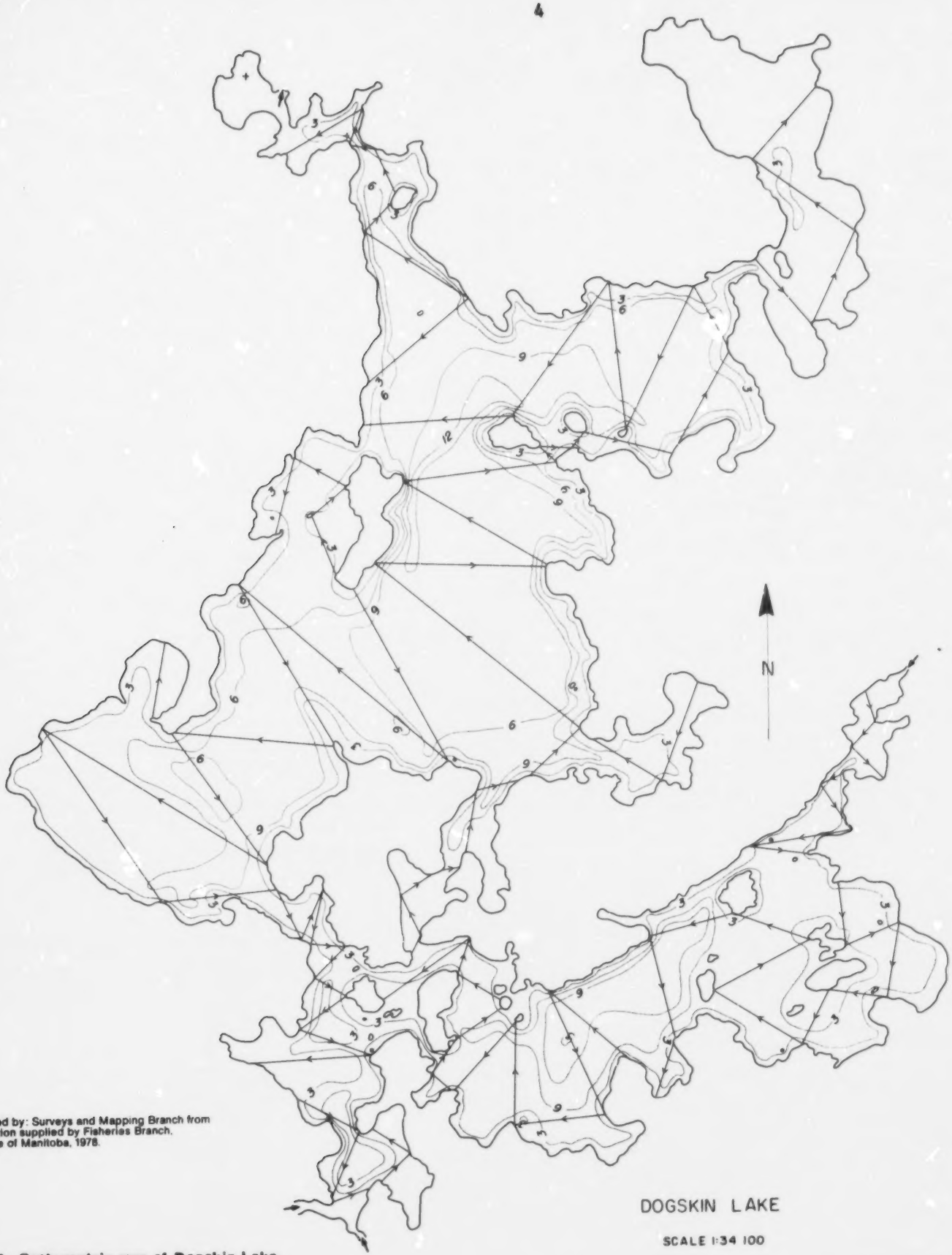
All of the lakes are located on the Precambrian Shield. The topography of the area is Precambrian drift plain of a rolling to hilly nature. The surface deposits consist of varying amounts and thicknesses of glacial drift with abundant rock outcrop. Bogs and lakes cover 40 to 60 percent of the surface (Wier, 1960). A more complete description of the geology and soil composition of the area may be obtained from Woo et al (1977) and Dutchak et al (1978).

The natural vegetation of the area is northern coniferous forest consisting mainly of black spruce (Picea mariana), white spruce (Picea glauca), and balsam fir (Abies balsamea). There is jackpine (Pinus banksiana) white birch (Betula papyrifera) and balsam poplar (Populus balsamifera) in areas of recent burns. (Wier, 1960).

The principal species of emergent vegetation in these lakes were yellow water lily (Nuphar variegatum), floating leaf pondweed (Potamogeton natens), coontail (Ceratophyllum sp), cattail (Typha sp) and bulrush (Scirpus sp).

Dogskin Lake is a headwater lake with a relatively small drainage basin. The main inflow is Irwin Creek. There are two other small inflowing creeks, one from Frances Lake and one at the south end bog area. The only outflow is the Dogskin River (Fig. 2).

Family Lake is also a headwater lake with a slightly larger drainage basin. The main inflow is the Dogskin River. There are six small creeks draining small lakes and bog areas on the east side of Family Lake. There are two more small creeks at the south end and three on the west side of Family Lake. All drain small lakes and bog areas. Family Lake has two outflows, the Berens River and the Pigeon River (Fig. 3).



Produced by: Surveys and Mapping Branch from information supplied by Fisheries Branch. Province of Manitoba, 1978.

Fig. 2. Bathymetric map of Dogskin Lake.

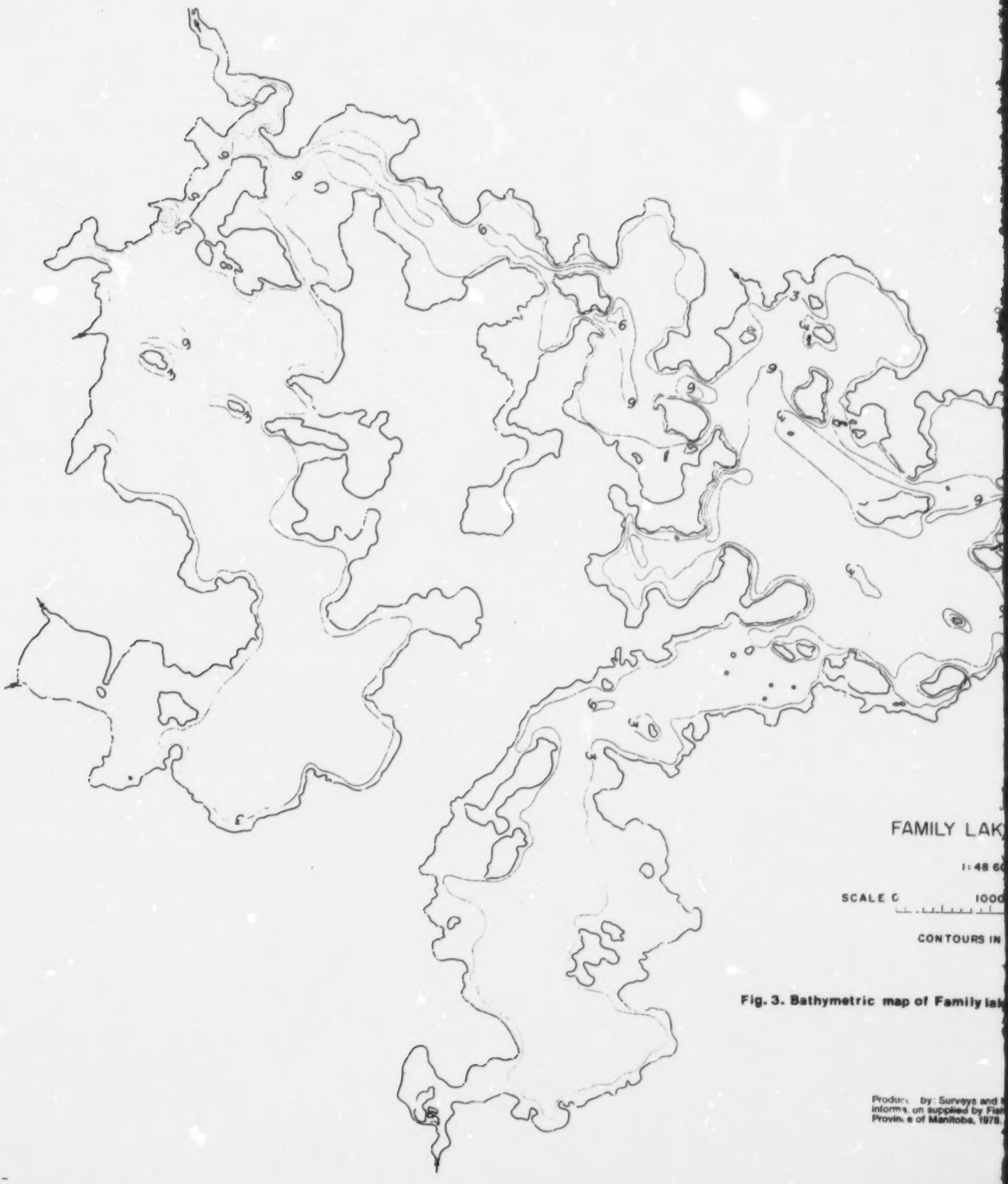


Fig. 3. Bathymetric map of Family lak

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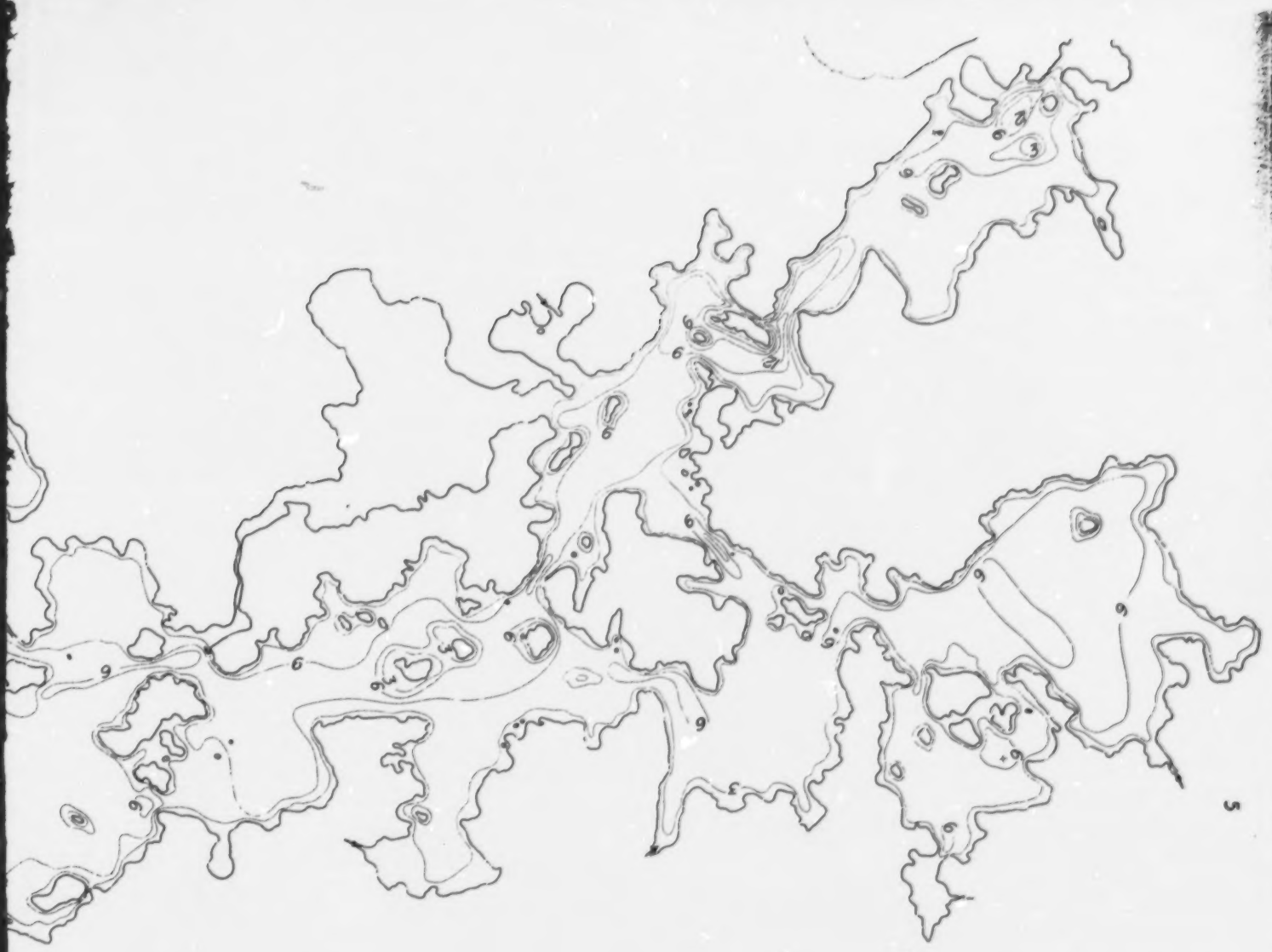
Provin... e of Manitoba, 1978.



AMILY LAKE (S. end)

1:48 600

1000 2000 METRES

CONTOURS IN METRES

of Family lake.

by: Surveys and Mapping Branch from
on supplied by Fisheries Branch,
of Manitoba, 1978.

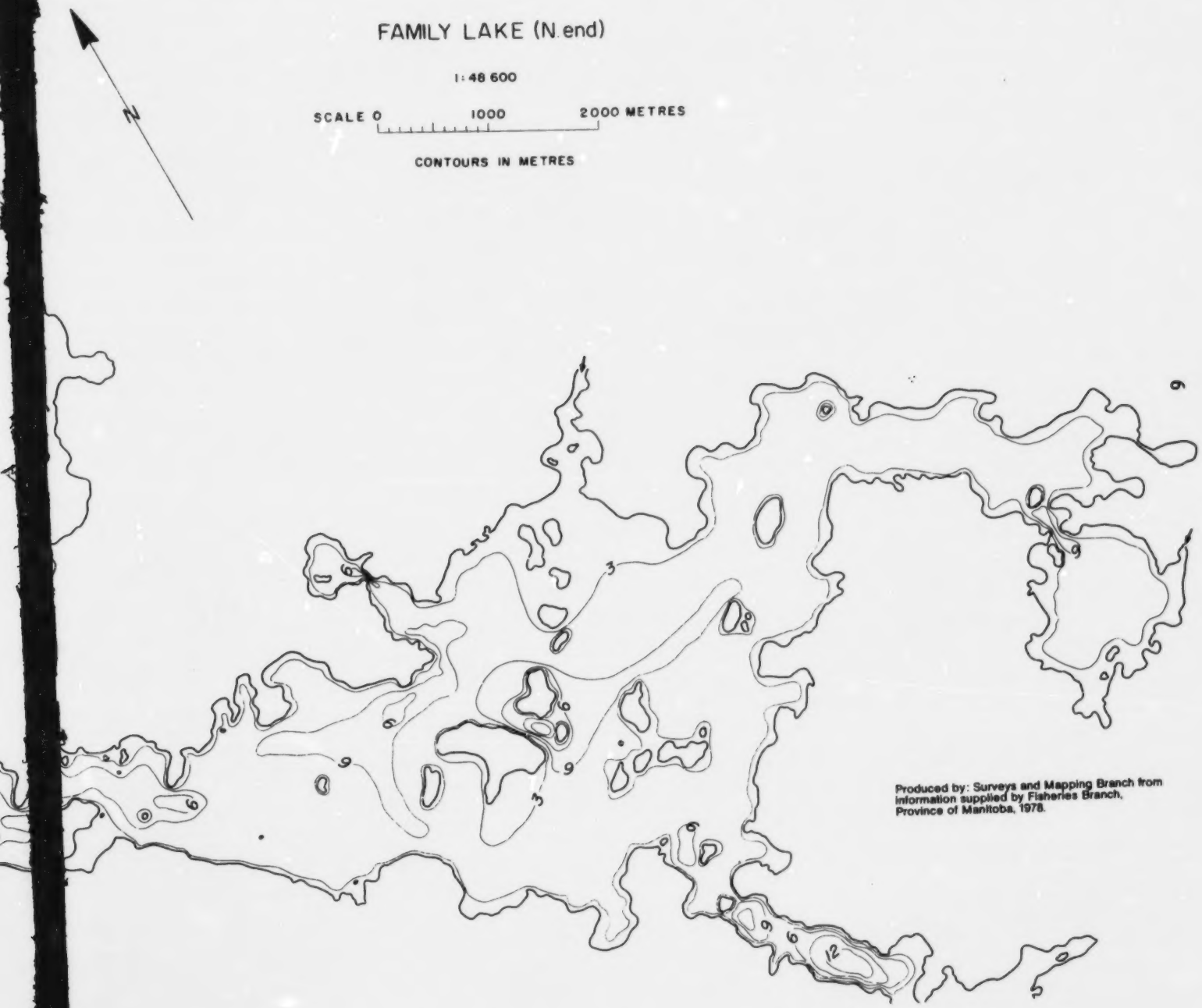
Fig. 3. con't.

FAMILY LAKE (N.end)

1:48 600

SCALE 0 1000 2000 METRES

CONTOURS IN METRES



Produced by: Surveys and Mapping Branch from information supplied by Fisheries Branch, Province of Manitoba, 1978.

Viking and Vickers Lakes are flow through lakes on the Pigeon River. The main inflow and outflow for both being the Pigeon River. In addition each lake has a few small creeks, draining bog and marsh areas (Figs. 4 and 5).

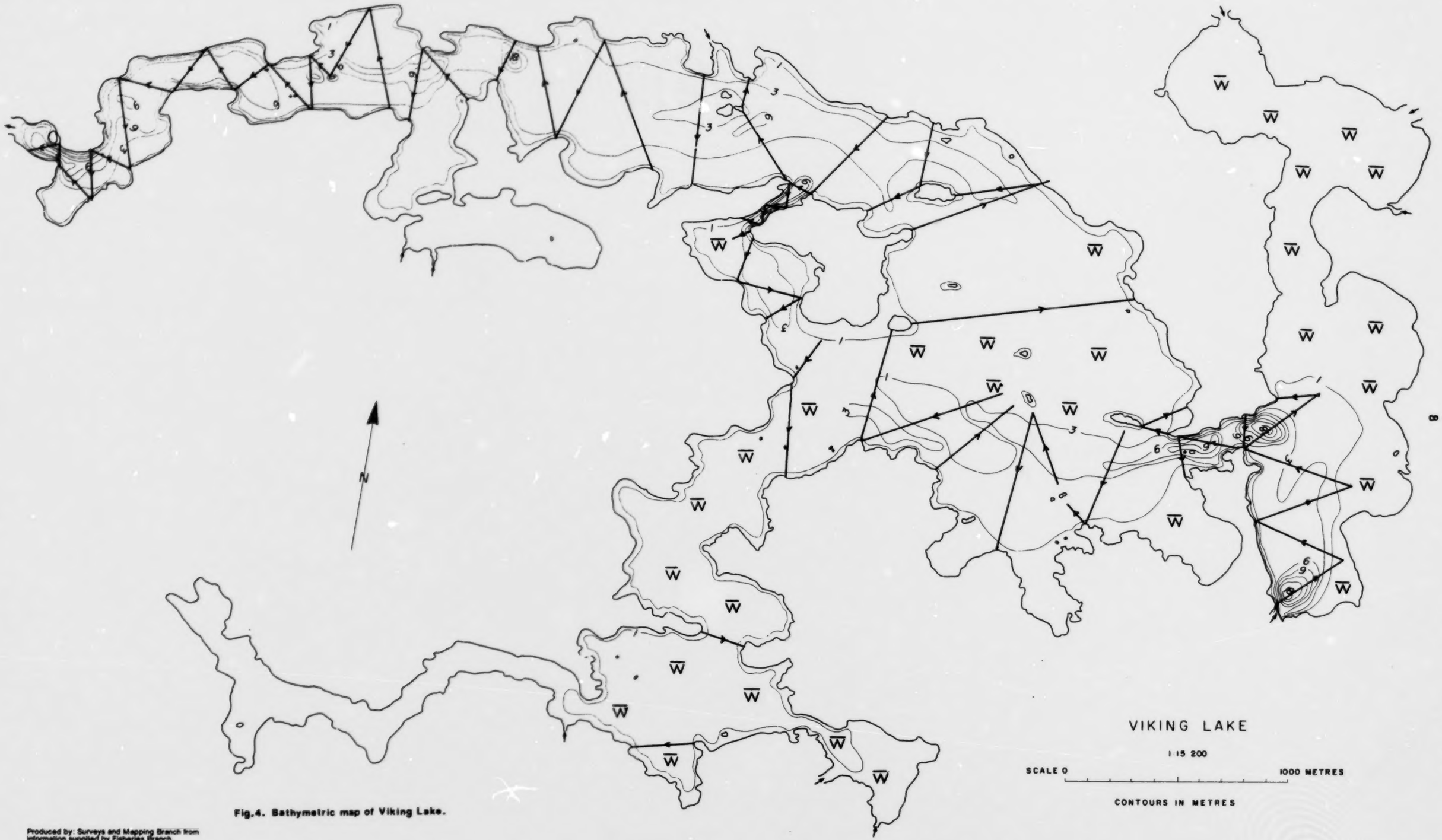


Fig.4. Bathymetric map of Viking Lake.

Produced by: Surveys and Mapping Branch from information supplied by Fisheries Branch, Province of Manitoba, 1978.

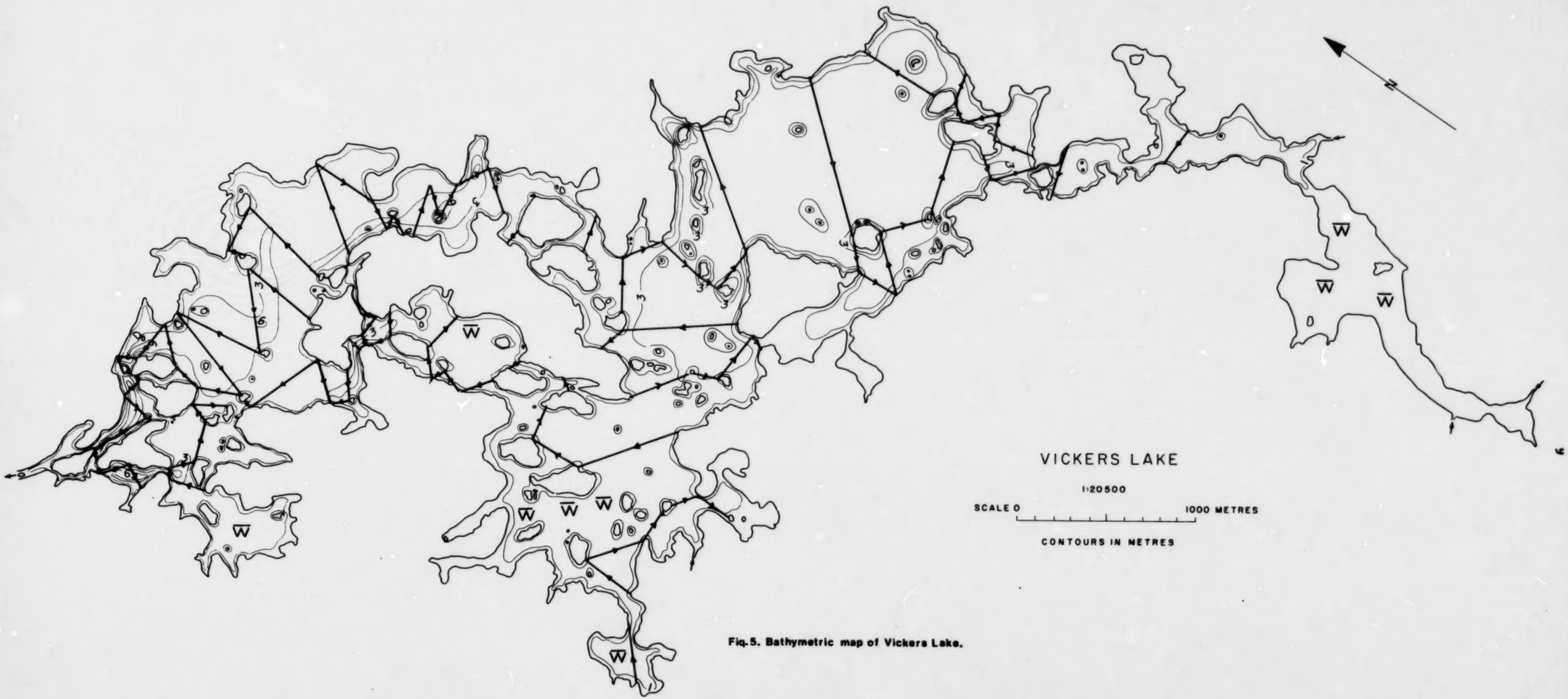


Fig. 5. Bathymetric map of Vickers Lake.

Produced by: Surveys and Mapping Branch from information supplied by Fisheries Branch, Province of Manitoba, 1978.

METHODS

The number of transects run for bathymetric mapping varied with each lake and was determined by the complexity of the lake basin. The depth sounding in this survey was done with a Furuno FG 200 MK 3 unit with a range of 0 to 87 meters. The unit was attached to a 4.3 meter inflatable boat powered by a 20 H. P. outboard. The locations of the transects were drawn on a work map prior to sounding. Some of the transects were later modified after substituting more prominent land marks for start and stop points.

The number of chemical stations was not fixed and varied according to the complexity of the lake basin and the location of inflowing streams. At the chemical stations complete sets of data including temperature, dissolved oxygen, conductance and pH were recorded. The water temperature and dissolved oxygen profiles were recorded at one meter intervals from the surface to the bottom with a YSI electronic instrument.

The transparency of the water was measured with a standard limnological Secchi disc, according to Welch (1948).

The conductance was measured with a YSI electronic instrument at the surface.

The pH at each station was measured with a Hach wide range colour comparator field kit.

The number of stations for collection of water samples was two per lake. Three, one liter samples were collected from each station. One was fixed with 2.5 ml nitric acid (50%). The samples were then frozen and submitted at a later date for analysis. The analyses of the water samples were done by the Environmental Management Division of the Department of Mines and Environment.

Plankton samples were collected at chemical station sites with a 25 cm Wisconsin plankton tow of 73 micron Nitex. In addition, plankton samples were collected from all areas of emergent vegetation with a long handle plankton sweep net also of 73 micron Nitex. The samples were preserved in the field in 10% formalin for identification and analysis later.

Benthos samples were collected from each station with a 15 cm by 15 cm Ekman dredge. The samples were washed in the field in a 400 micron Nitex bag and preserved in 10% formalin for identification and analysis later.

Small fish specimens (forage fish) were collected by seining a suitable area with a 1.2 m by 7.4 m minnow seine of 6 mm oval mesh. This was supplemented with samples taken with the fish toxicant, rotenone. A small bay or area of the lake was selected, preferably one that could be blocked off with the seine, and rotenone was then gradually dispensed into the water in the prop wash. It was thoroughly mixed into the water by traversing the treated area by boat several times.

The intensity of standard gang gill net sampling was predetermined at one set per 200 hectares of surface area. This figure then was subjectively varied according to the complexity of the lake morphometry. Eight net sets were made in Viking and Vickers lakes, twelve in Dogskin and twenty in Family Lake. The standard gang was comprised of six nets of different mesh sizes, each being 22.9 m in length and 1.8 m deep. The mesh sizes were randomized as 3.8 cm, 9.5 cm, 5.1 cm, 10.8 cm, 7.6 cm, and 12.7 cm in order. The gill net sets were rotated around the lake to sample as many different habitat types and depth zones as possible.

The sport species, walleye (Stizostedion vitreum) and northern pike (Esox lucius) were sampled for fork length, weight, sex, maturity and stomach contents. For age determination, the otoliths and first two dorsal rays were taken from the walleye and the first two pelvic rays were taken

from the northern pike. All other species of fish were measured for fork length and weight only. Age determination of the calcified structures was achieved by sectioning the structures and reading the annuli under high power magnification on a microfiche reader.

Calculations

The morphometric calculations such as length of lake shoreline, island shoreline length, total surface area and area of each depth contour were determined according to Hutchinson (1957).

The morphoedaphic index (MEI) was calculated according to Ryder (1965).

The regression analysis of growth data was calculated according to Snedecor and Cochran (1967).

The mean weighted age of onset of sexual maturity (Z value) was calculated according to Abrosov (1967).

RESULTS

Drainage Divisions

The watershed divisions that contain the lakes surveyed are summarized in Table 1. Also shown is the area of each watershed unit (Fedoruk, 1970).

Table 1. Drainage divisions and watershed units of Manitoba that contain the lakes surveyed.

Principal drainage division			Major drainage division			Watershed unit			Lake
No.	Name	Approx. area in Manitoba in sq km	No.	Name	Approx. area in Manitoba in sq km	No.	Name	Approx. area in Manitoba in sq km	
5	Nelson River	313,131	5RD	Berens River lower division	7,933	5RDK	Dogskin Lake	461	Dogskin
						5RDJ	Family Lake region	642	Family
						5RDM	Pigeon River upper region	350	Viking Vickers

Bathymetric mapping

The morphometry of the lakes surveyed was diverse. The shoreline development index ranged from 4.6 on Dogskin Lake to 8.5 on Family Lake. Viking and Vickers lakes each had a shoreline development index of 5.2. Bathymetric maps are presented in Figs. 2 to 5. The morphometry of the lakes is summarized in Table 2.

Physical and chemical parameters

The Secchi disc transparencies for the lakes were as follows:

Dogskin	2.5 m	June 26
Family	2.5 m	June 29
Viking	1.0 m	July 9
Vickers	1.5 m	July 1

Temperature - dissolved oxygen profiles of the lakes showed all to be isothermal with saturated or near saturated levels of dissolved oxygen, (Figs. 6 to 9). The locations of the sampling stations are illustrated in Figs. 10 to 13.

The average pH of the lakes ranged from 7.0 in Dogskin Lake to 7.7 in Family Lake. Viking and Vickers lakes' each had an average pH of 7.5.

Dissolved minerals in these lakes were dominated by bicarbonates and sodium (Table 3). The total dissolved solids (TDS) ranged from 45.5 mg/l in Vickers Lake to 78.0 mg/l in Family Lake.

The nutrient concentrations of the lakes were low. The total dissolved nitrogen, nitrites and nitrates were <0.01 mg/l and the total phosphorus concentration was <0.02 mg/l for all lakes.

Table 2. Morphometry of the lakes surveyed.

	Dogskin	Family	Viking	Vickers
Area (ha)	1760	10,986	778	699
Maximum depth (m)	12.0	54.0	18.0	6.0
Mean depth (m)	5.0	4.0	1.9	2.2
Volume ($m^3 \times 10^6$)	88.8	464.3	15.0	15.4
Length of shoreline (km)	69.0	315.0	51.2	49.0
Length of island shoreline (km)	20.0	122.0	6.6	38.3
Total length of shoreline (km)	89.0	437.0	57.8	87.3

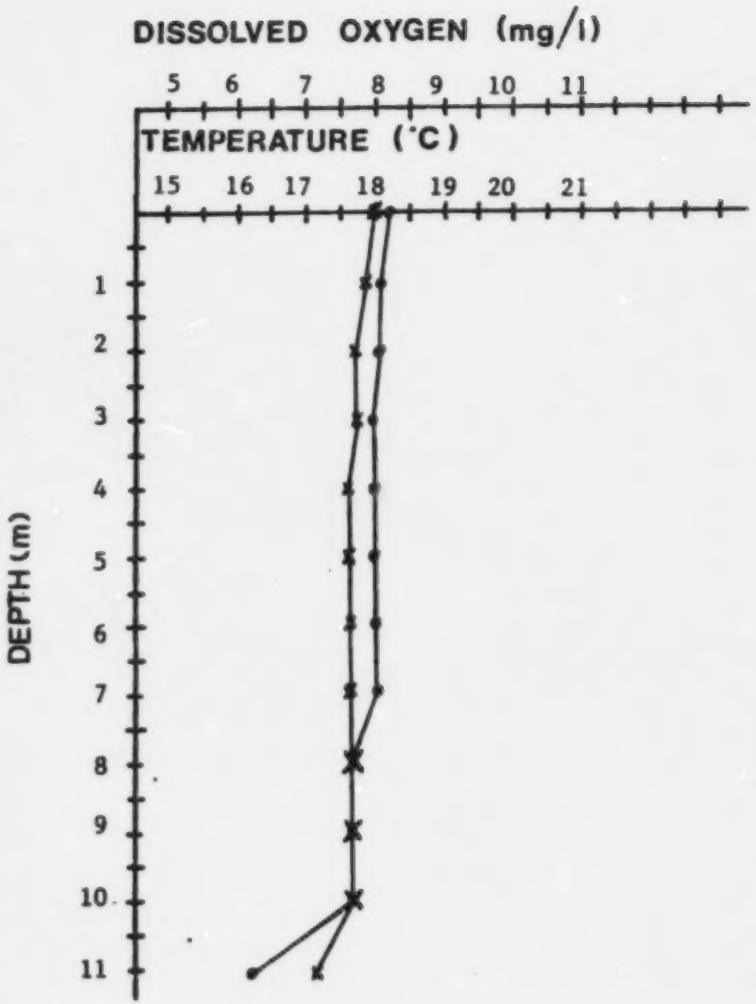


Fig. 6. Temperature ×—× dissolved oxygen •—• profile of Dogskin Lake, August 3, 1978.

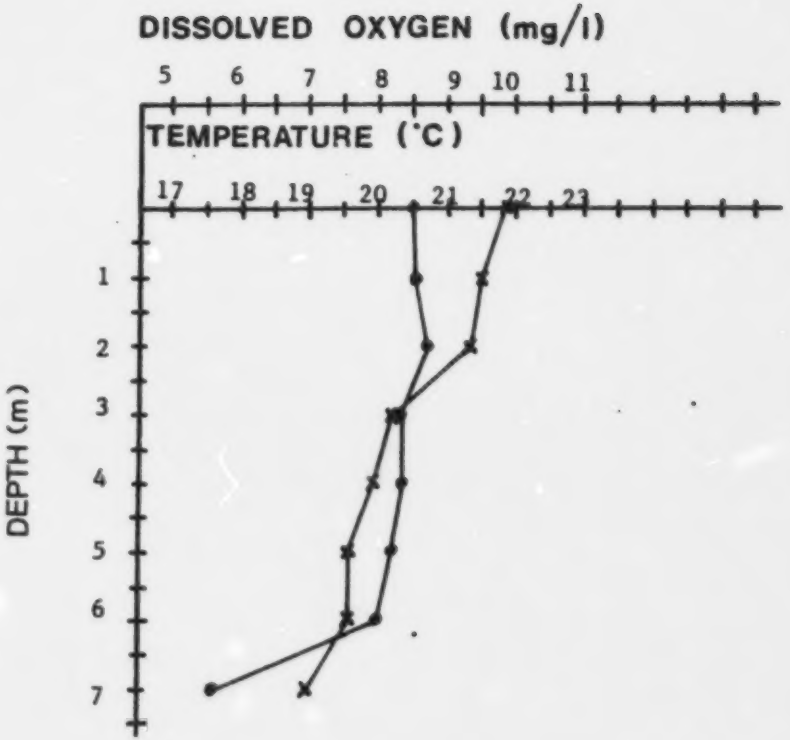


Fig.7. Temperature ×—× dissolved oxygen •—• profile of Family Lake, July 5,1978.

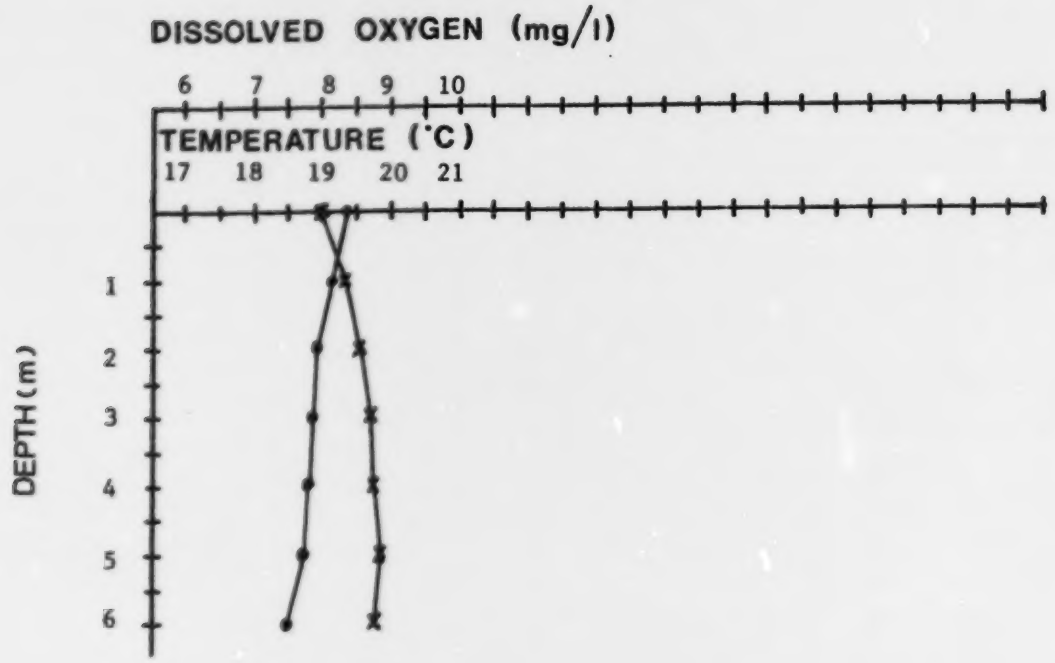


Fig. 8. Temperature ×—× dissolved oxygen •—• profile of Viking Lake, July 9,1978.

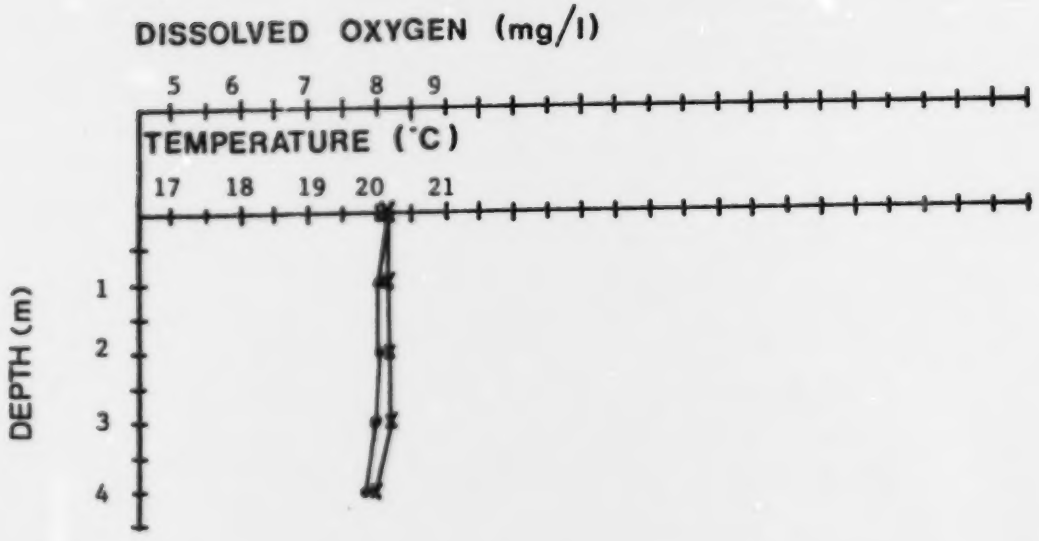


Fig. 9. Temperature ×—× dissolved oxygen •—• profile of Vickers Lake, July 11,1978.

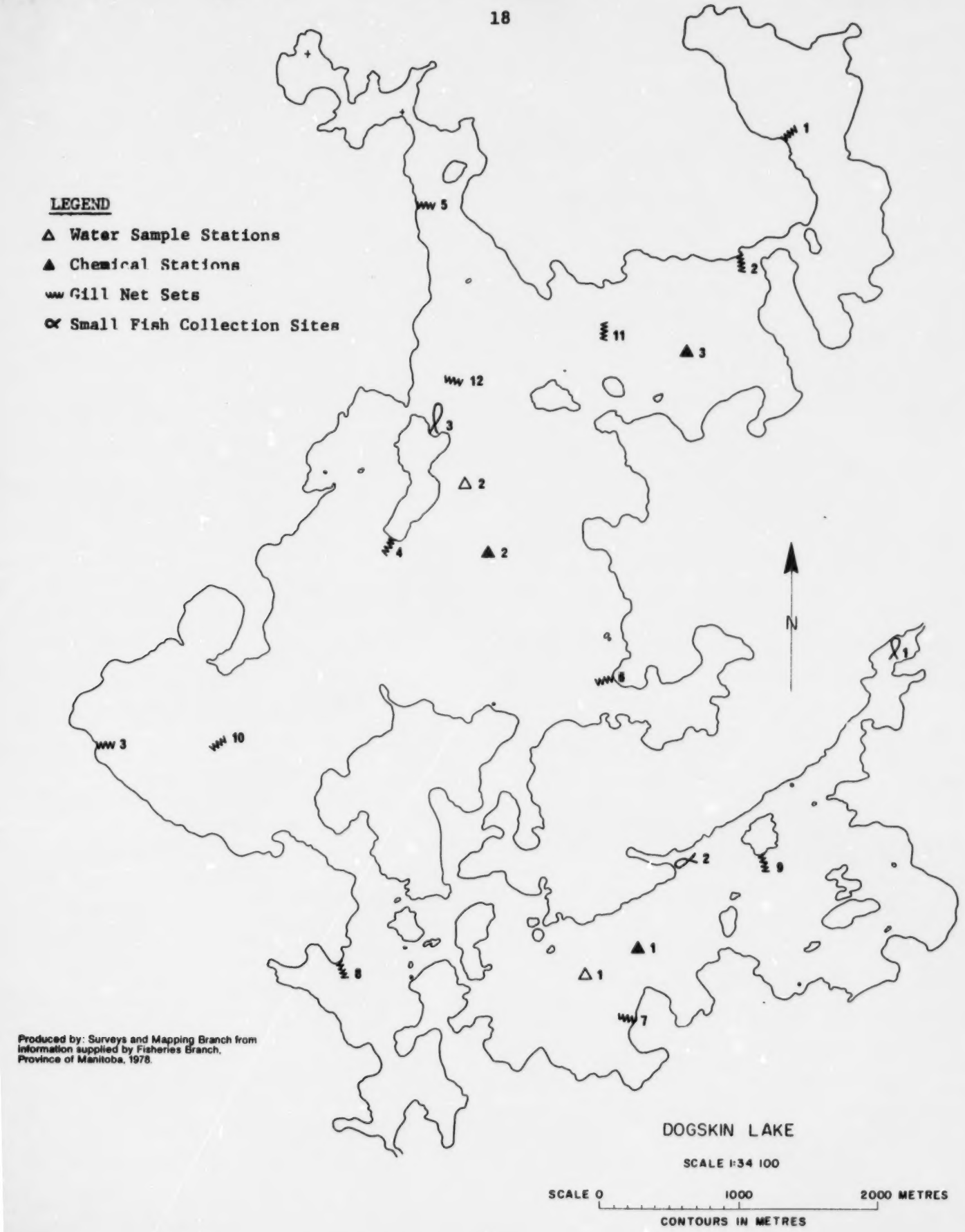


Fig. 10. Location of chemical stations, small fish collection sites and gill net sets in Dogskin Lake, 1978.

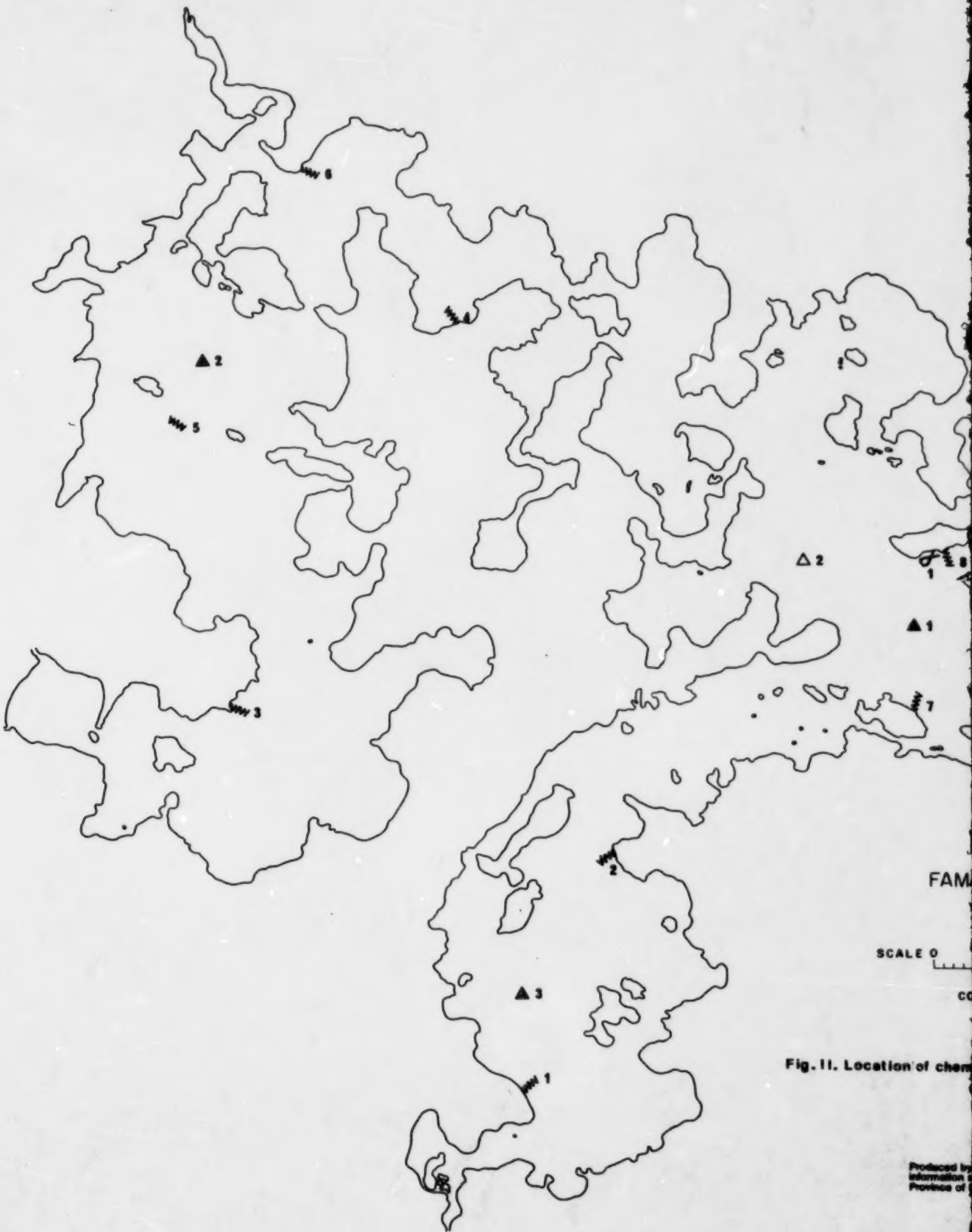


Fig. 11. Location of chem

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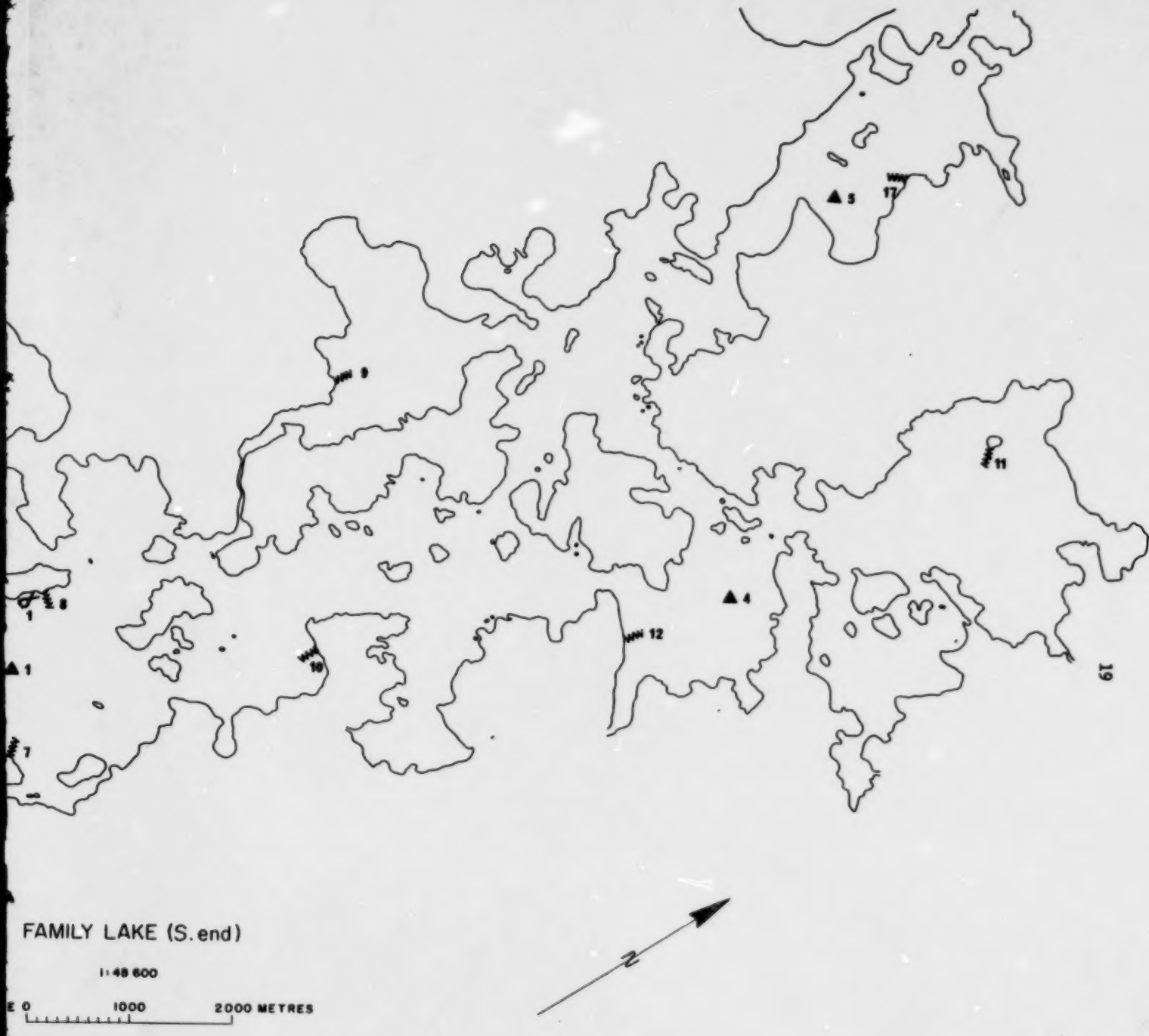

of chemical stations, small fish collection sites and gill net sets in Family Lake, 1978.

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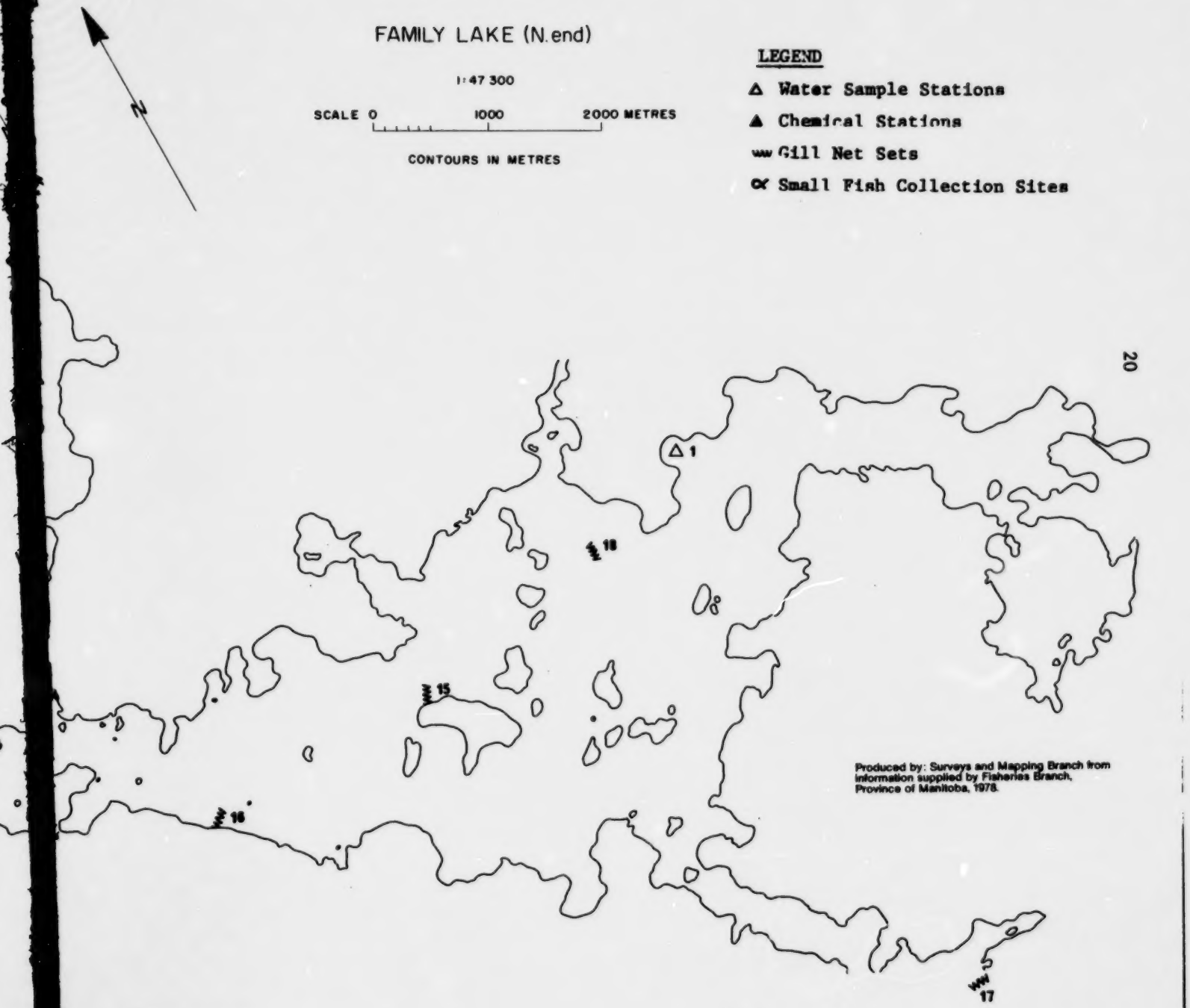
Fig. 11 con't.


FAMILY LAKE (N.end)
1:47 300
SCALE 0 1000 2000 METRES
CONTOURS IN METRES
N
LEGEND
Water Sample Stations
Chemical Stations
Gill Net Sets
Small Fish Collection Sites
20
1
18
15
16
17
Produced by: Surveys and Mapping Branch from information supplied by Fisheries Branch, Province of Manitoba, 1978.

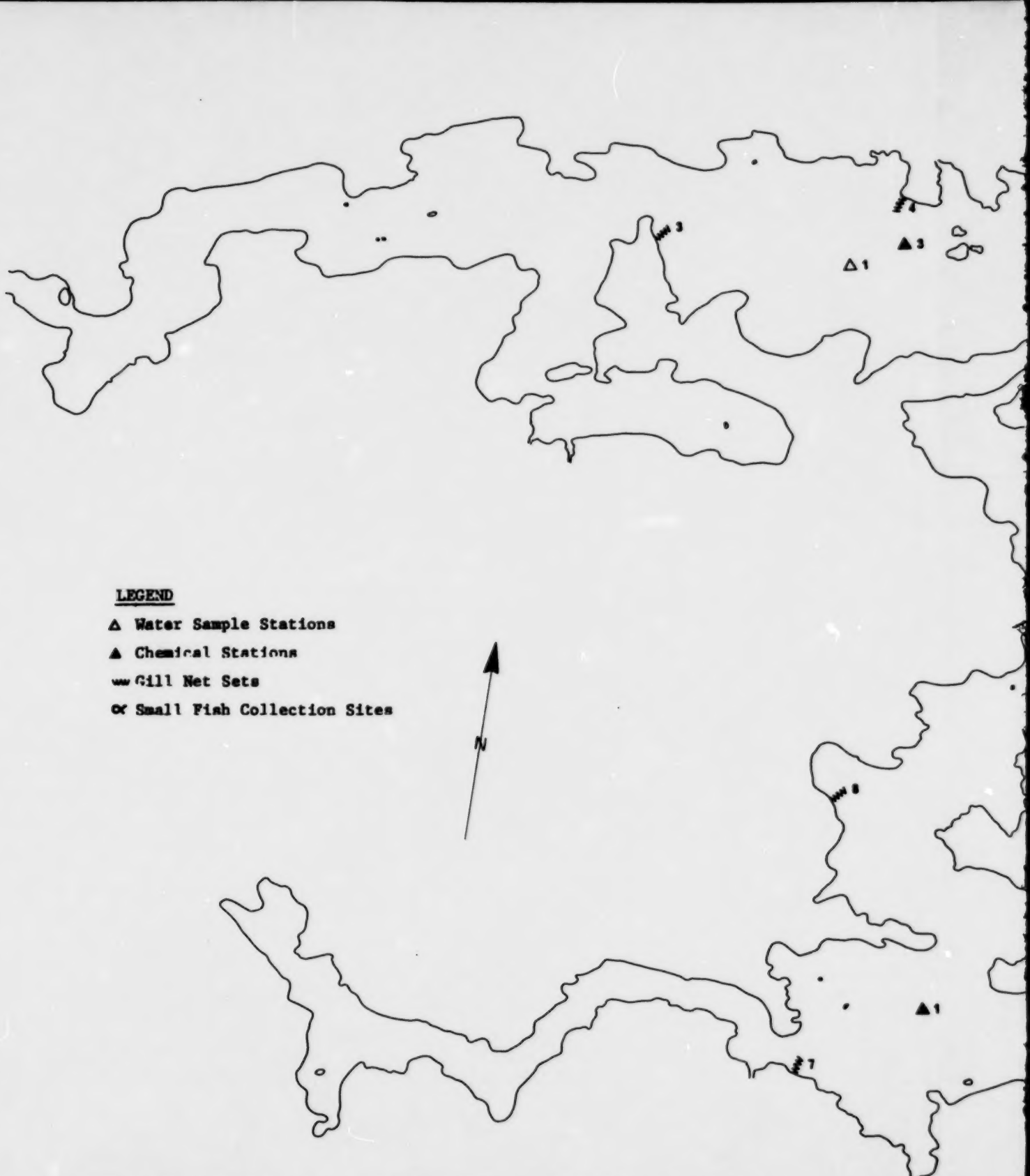


Fig. 12. Location of chemical stations, small fish collection sites and gill net sets in Viking Lake, 1978.

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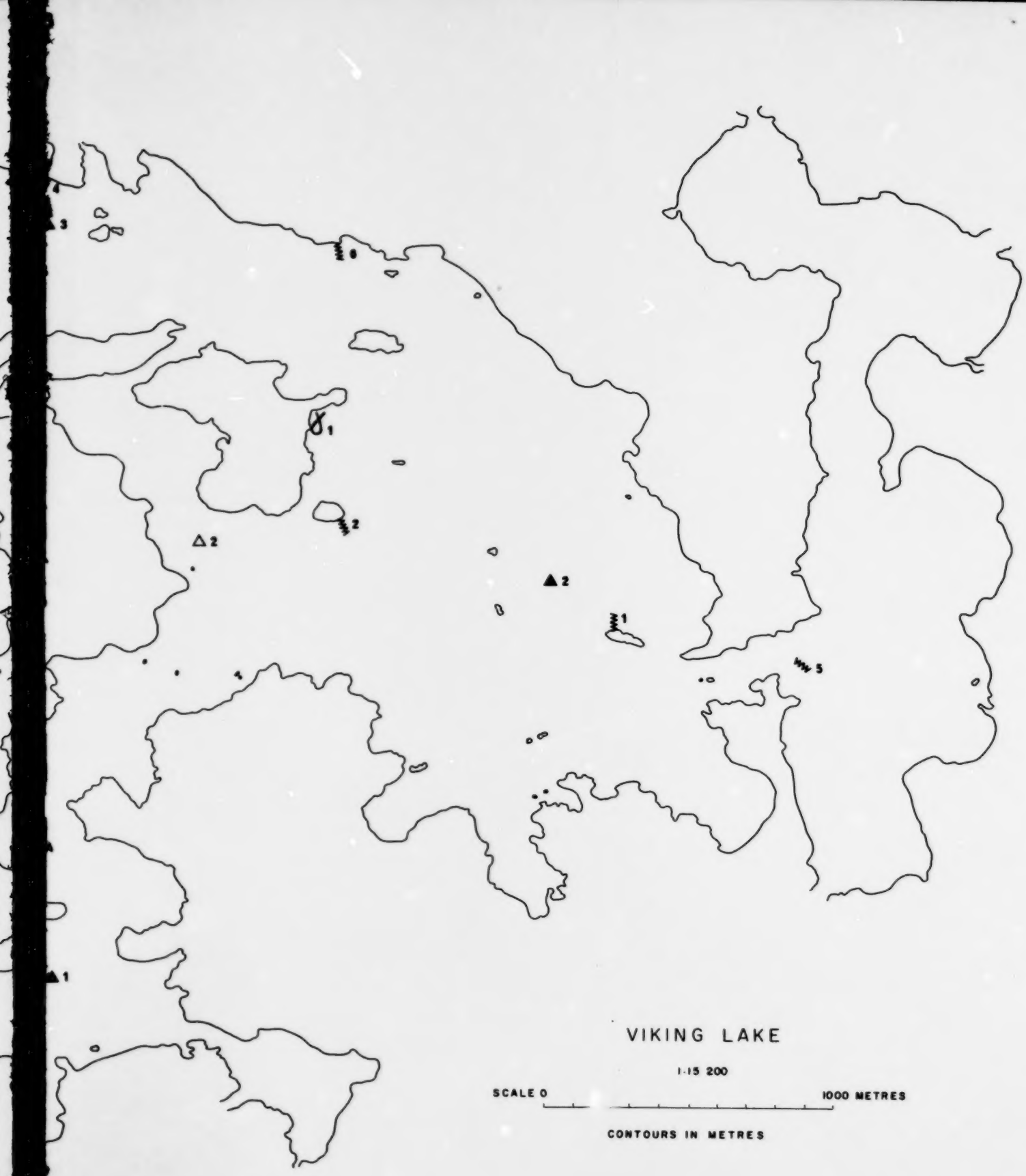
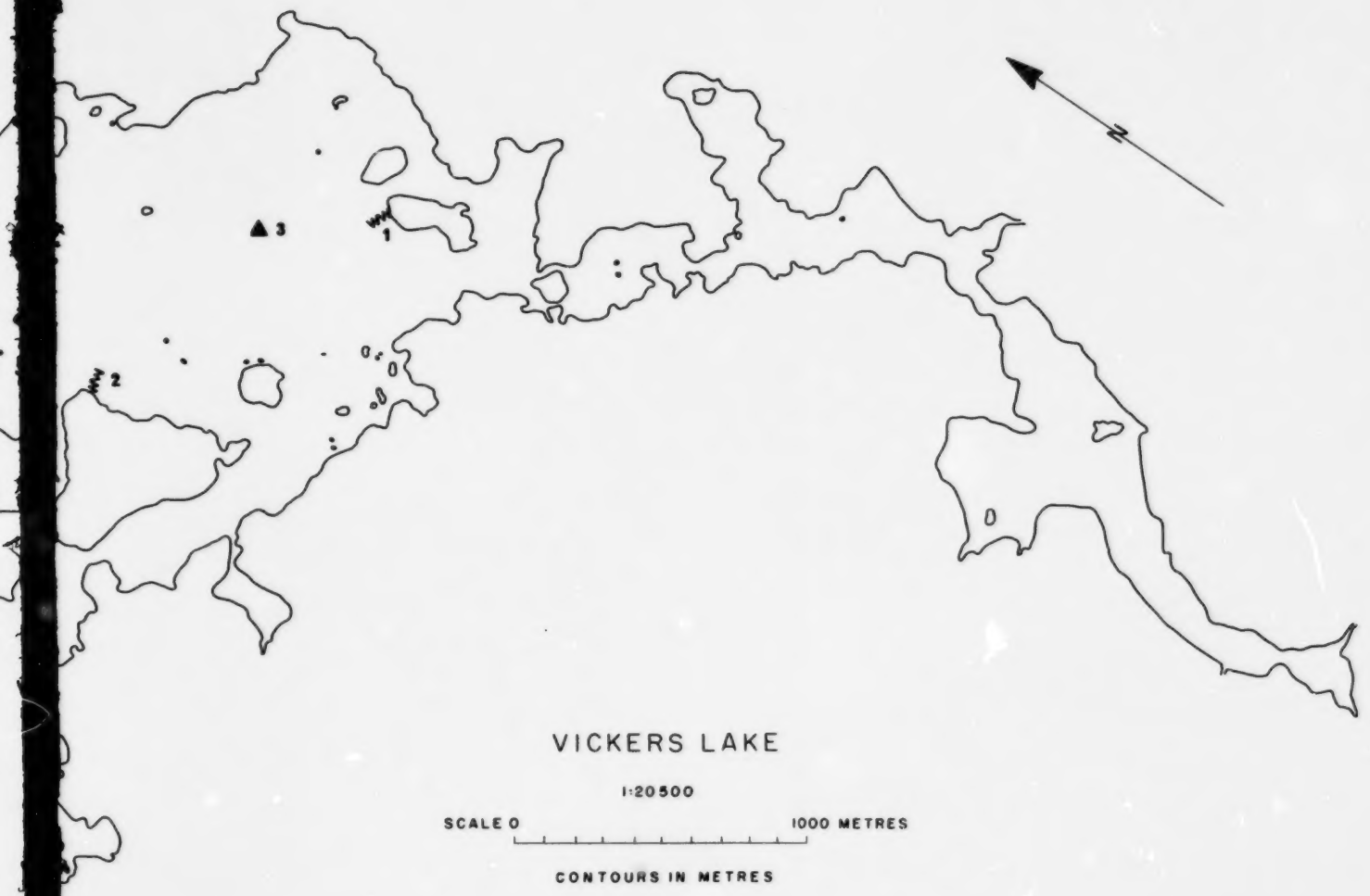

VIKING LAKE
1:15 200
SCALE 0
1000 METRES
CONTOURS IN METRES

Produced by: Surveys and Mapping Branch from information supplied by Fisheries Branch, Province of Manitoba, 1978.

Fig. 13. Location of chemical stations, small fish collection sites and gill net sets in Vickers Lake, 1978.



VICKERS LAKE

1:20500

SCALE 0 1000 METRES

CONTOURS IN METRES

LEGEND

△ Water Sample Stations

▲ Chemical Stations

ww Gill Net Sets

ᘐ Small Fish Collection Sites

, 1978.

Table 3. Water chemistry analysis of the lakes - June 26 to July 9, 1978.

Parameter	Dogskin	Family	Viking	Vickers
pH	7.0	7.7	7.5	7.5
Conductivity, (umho/cm)	30.8	46.2	44.1	50.1
Total Residue, (mg/l)	56.0	81.0	67.0	70.1
Filterable Residue, (mg/l)	56.0	78.0	67.0	45.5
Non-filterable Residue, (mg/l)	<5.0	<5.0	<5.0	25.5
Calcium (Ext) (mg/l)	<5.0	<5.0	<5.0	<5.0
Magnesium (Ext) (mg/l)	<5.0	<5.0	<5.0	<5.0
Hardness ($CaCO_3$) (mg/l)	16.0	16.0	16.0	16.0
Potassium (Ext) (mg/l)	<2.0	<2.0	<2.0	<2.0
Sodium (Ext) (mg/l)	<10.0	<10.0	<10.0	<10.0
Colour (true hazen units)	>50.0	>50.0	>50.0	>50.0
Turbidity, NTU	1.7	1.7	1.7	1.5
NO_3-NO_2-N (Diss) (mg/l)	<0.01	<0.01	<0.01	<0.01
Phosphorus Total (mg/l)	<0.02	<0.02	<0.02	<0.02
Chlorine (sol) (mg/l)	<2.0	<2.0	<2.0	<2.0
Sulfate (sol) (mg/l)	7.5	5.0	9.0	10.0

Benthos

The benthic organisms collected during this survey are summarized in appendix 1.

Plankton

The plankton specimens collected during this survey are summarized in appendix 2.

Small fish collection

There were thirteen species of small fish collected from the lakes. A summary of the species collected is presented in Table 4. The locations of the collection sites are illustrated in Figs. 10 to 13.

Large fish collection

A total of 48 net sets were made in the four lakes. These produced eleven species of fish which are summarized by numbers and weight per mesh size in Tables 5 to 8. The locations of the gill net sets are illustrated in Figs. 10 to 13.

Stomach contents

The stomach contents of the sport species, walleye and northern pike were examined to obtain information on diet. Dogskin Lake walleye contained digested invertebrate remains and some digested fish remains. The northern pike from Dogskin contained predominantly digested fish remains and crayfish. Family Lake walleye and northern pike showed the same contents and relative abundance in diet as did those from Dogskin Lake. Viking Lake walleye had more digested fish remains although, digested invertebrate remains, still predominated. Northern pike from Viking Lake had mostly digested fish remains,

Table 4. Small fish from the lakes surveyed.

Species	Dogskin	Family	Viking	Vickers
Spottail shiner (Notropis hudsonius)	*	*		
Emerald shiner (Notropis atherinoides)	*			
Walleye (Stizostedion vitreum)	*		*	*
White sucker (Catostomus commersoni)	*		*	*
Trout perch (Percopsis omiscomaycus)	*	*		
Slimy sculpin (Cottus cognatus)		*		
Burbot (Lota lota)		*		
Longnose dace (Rhinichthys cataractae)			*	
Bluntnose minnow (Pimephales notatus)			*	
Rock bass (Ambloplites rupestris)			*	*
Johnny darter (Etheostoma nigrum)				*
Mimic shiner (Notropis vollucellus)				*
Yellow perch (Perca flavescens)				*

Table 5. Gill net summary Dogskin Lake.

Species		Mesh Size (cm) 3.81	5.08	7.62	9.52	10.79	12.70	Total	%
Walleye (Stizostedion vitreum)	No.	19	102	168	111	40	15	455	55.6
	kg.	7.9	49.8	125.4	94.3	48.3	23.6	349.4	
Northern Pike (Esox lucius)	No.	8	13	53	29	10	0	113	13.8
	kg.	9.7	17.1	70.3	37.6	20.2		154.9	
Lake whitefish (Coregonus clupeaformis)	No.	0	0	3	3	3	10	19	2.3
	kg.	-		4.6	4.5	5.6	17.1	31.8	
Shorthead redhorse (Moxostoma macrolepidotum)	No.	3	10	3	15	4	6	41	5.0
	kg.	2.8	6.5	2.9	14.6	5.4	8.9	41.1	
White sucker (Catostomus commersoni)	No.	0	3	5	5	4	2	19	2.3
	kg.		1.4	4.1	4.7	5.5	3.1	18.8	
Tullibee (Coregonus artedii)	No.	23	57	68	18	1	0	167	20.4
	kg.	3.0	11.8	18.8	6.0	0.4		40.0	
Yellow perch (Perca flavescens)	No.	4	0	1	0	0	0	5	0.6
	kg.	0.2		0.4				0.6	
Total	No.	57	185	301	181	62	33	819	
	kg.	23.6	86.6	226.5	161.7	85.4	52.7	636.6	

Table 6. Gill net summary Family Lake.

Species		Mesh Size (cm) 3.81	5.08	7.62	9.52	10.79	12.70	Total	%
Walleye (Stizostedion vitreum)	No.	20	49	146	85	28	0	328	33.2
	kg.	7.4	23.3	96.6	63.4	25.7		216.4	
Northern pike (Esox lucius)	No.	18	27	106	16	6	0	173	17.5
	kg.	15.9	27.1	105.4	14.8	14.3		177.5	
Sauger (Stizostedion canadense)	No.	8	33	8	2	0	0	51	5.2
	kg.	1.6	6.8	2.9	0.4			11.7	
Lake whitefish (Coregonus clupeaformis)	No.	0	1	8	7	10	13	39	4.0
	kg.		0.6	5.8	7.2	12.1	20.2	45.9	
Shorthead redhorse (Moxostoma macrolepidotum)	No.	0	20	9	4	4	3	40	4.1
	kg.		5.6	8.5	4.7	4.5	2.7	26.0	
White sucker (Catostomus commersoni)	No.	0	7	12	10	17	8	54	5.5
	kg.		1.0	14.4	7.8	20.5	13.9	57.6	
Tullibee (Coregonus artedii)	No.	63	44	91	27	33	1	259	26.2
	kg.	4.1	10.4	45.8	16.0	22.3	0.8	99.4	
Yellow perch (Perca flavescens)	No.	26	8	2	1	0	0	37	3.7
	kg.	1.4	1.1	0.5	0.1			3.1	
Rock bass (Ambloplites rupestris)	No.	3	0	0	3	0	0	6	0.6
	kg.	0.4			0.7			1.1	
TOTAL	No.	138	189	382	155	98	25	987	
	kg.	30.8	75.9	279.9	115.1	99.4	37.6	638.7	

Table 7. Gill net summary Viking Lake.

Species		Mesh Size (cm) 3.81	5.08	7.62	9.52	10.79	12.70	Total	%
Walleye (Stizostedion vitreum)	No.	6	15	25	25	10	1	82	16.5
	kg.	0.7	8.0	15.6	18.5	8.3	0.7	51.8	
Northern pike (Esox lucius)	No.	7	14	19	10	2	0	52	10.8
	kg.	13.5	13.3	22.8	17.3	7.8		74.7	
Lake whitefish (Coregonus clupeaformis)	No.	0	0	0	1	2	2	5	1.0
	kg.				1.7	3.6	3.1	8.4	
Sauger (Stizostedion canadense)	No.	0	0	1	0	0	0	1	
	kg.			0.6				0.6	
Mooneye (Hiodon tergisus)	No.	5	123	25	25	5	1	184	36.9
	kg.	2.4	11.2	10.4	10.4	2.7	0.6	37.7	
Shorthead redhorse (Moxostoma macrolepidotum)	No.	0	0	6	0	4	2	12	2.4
	kg.			8.1		4.1	2.5	14.7	
White sucker (Catostomus commersoni)	No.	0	5	11	10	11	6	43	8.6
	kg.		2.8	10.5	8.3	13.0	7.7	42.3	
Tullibee (Coregonus artedii)	No.	0	0	1	4	2	0	7	1.4
	kg.			0.6	1.6	0.7		2.9	
Yellow perch (Perca flavescens)	No.	72	15	16	5	0	0	108	21.7
	kg.	5.3	3.1	4.1	1.6			14.1	
Burbot (Lota lota)	No.	1	0	0	3	0	0	4	0.8
	kg.	0.8			2.3			3.1	
TOTAL	No.	91	172	104	83	36	12	498	
	kg.	22.7	38.4	72.7	61.7	40.2	14.6	250.3	

Table 8. Gill net summary Vickers Lake.

Species		Mesh Size (cm) 3.81	5.08	7.62	9.52	10.79	12.70	Total	%
Walleye (Stizostedion vitreum)	No.	6	0	14	12	3	1	36	14.0
	kg.	1.2		10.8	6.7	3.2	0.7	22.6	
Northern pike (Esox lucius)	No.	1	2	12	1	2	0	18	7.0
	kg.	1.8	3.8	17.2	6.2	2.6		31.6	
Sauger (Stizostedion canadense)	No.	1	0	2	2	0	0	5	1.9
	kg.	0.6		0.7	0.9			2.2	
Mooneye (Hiodon tergisus)	No.	1	10	39	26	14	0	90	35.0
	kg.	0.5	4.4	19.1	11.5	8.2		43.7	
Shorthead redhorse (Moxostoma macrolepidotum)	No.	0	0	1	2	1	1	5	1.9
	kg.			1.0	3.9	1.8	0.9	7.6	
White sucker (Catostomus commersoni)	No.	0	0	4	6	3	2	15	5.9
	kg.			2.2	4.7	4.2	3.8	14.9	
Tullibee (Coregonus artedii)	No.	2	0	1	1	0	0	4	1.6
	kg.	0.5		0.9	0.5			1.9	
Yellow Perch (Perca flavescens)	No.	55	12	10	4	3	0	84	32.7
	kg.	2.8	1.6	2.4	0.6	0.7		8.1	
TOTAL	No.	66	24	83	54	26	4	257	
	kg.	7.4	9.8	54.3	35.0	20.7	5.4	132.6	

including yellow perch and walleye in their guts. Vickers Lake walleye were the only ones to show a predominance of digested fish remains in their guts. The northern pike from Vickers Lake mostly had empty guts. Very few had digested fish remains.

There was no stomach content analysis done for the other species captured during the survey.

Walleye age and growth

The growth of the walleye sampled from each of the lakes, in terms of length and weight, is shown in Fig. 14 and Fig. 15, respectively. The interval about the curves is plus and minus one standard error. ($\pm$ 1SE).

The age-frequency distribution of the walleye samples is illustrated in Fig. 16. There was fairly good representation of most age groups.

The length-weight relationship of the walleye sampled is shown in Figs. 17 and 18. The equation for the linear regression for each lake is:

Dogskin walleye

$$\text{Log}_e W = -10.3296 + 2.8109 \text{ Log}_e L$$

$$r = 0.9713, P<0.05$$

Family walleye

$$\text{Log}_e W = -9.970 + 2.7596 \text{ Log}_e L$$

$$r = 0.9506, P<0.05$$

Viking walleye

$$\text{Log}_e W = -10.6960 + 2.8806 \text{ Log}_e L$$

$$r = 0.9790, P<0.05$$

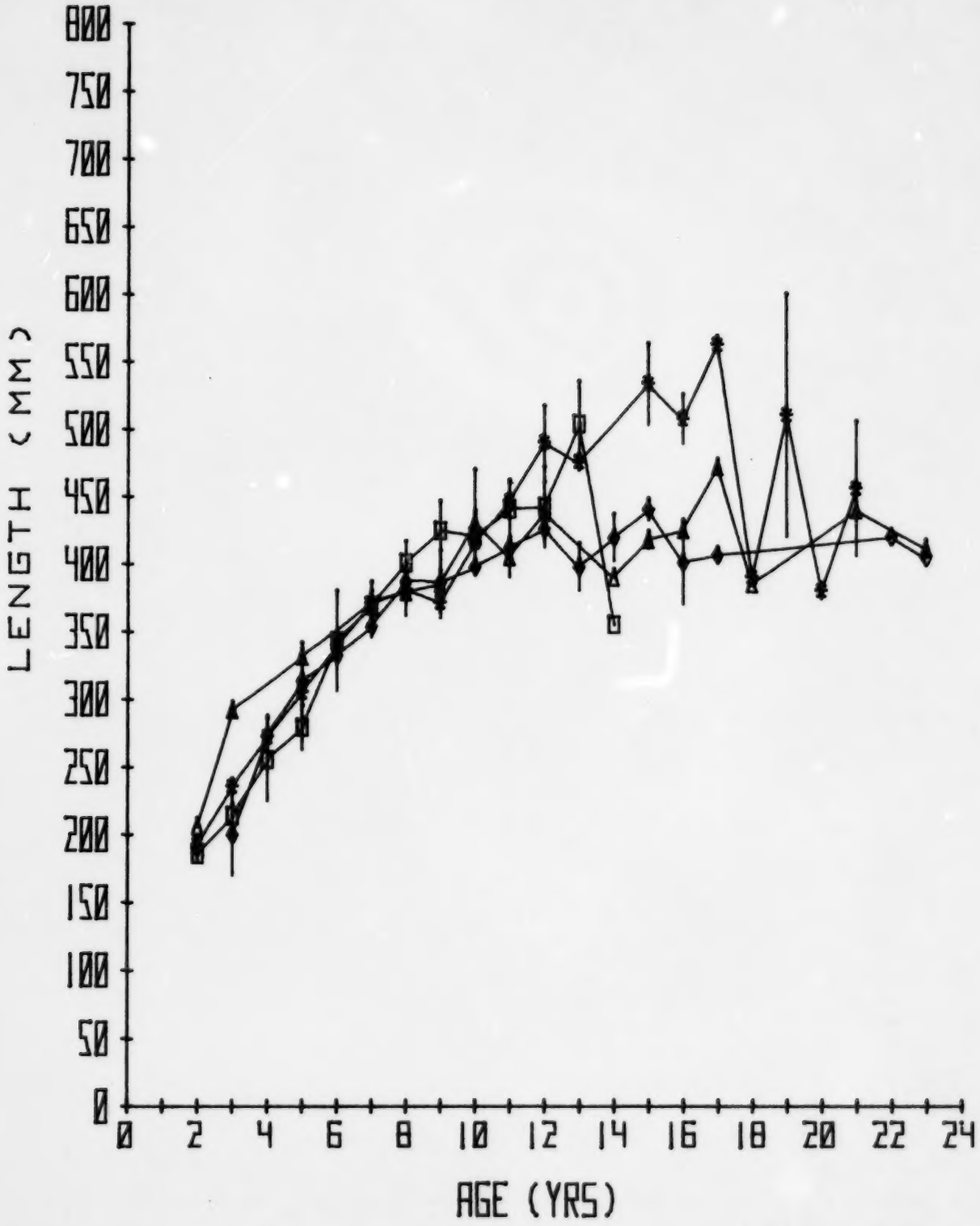


Fig. 14. Length–age relationship and standard error of means of walleye from the lakes surveyed. (Dogskin ●, Family ◆, Viking ▲, Vickers ◘).

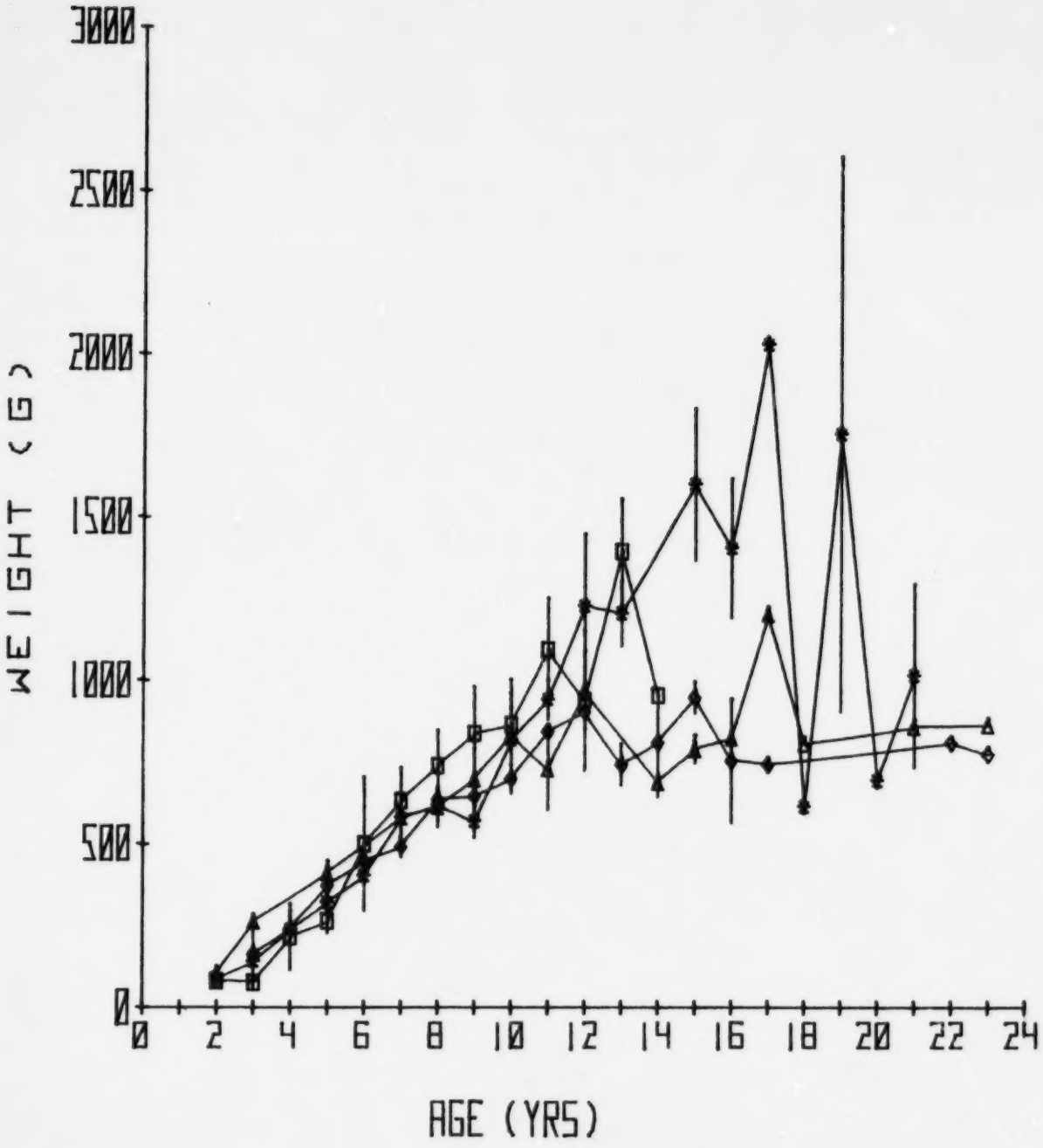


Fig. 15. Weight-age relationship and standard error of means of walleye from the lakes surveyed. (Dogskin ●, Family ◆, Viking ▲, Vickers ■).

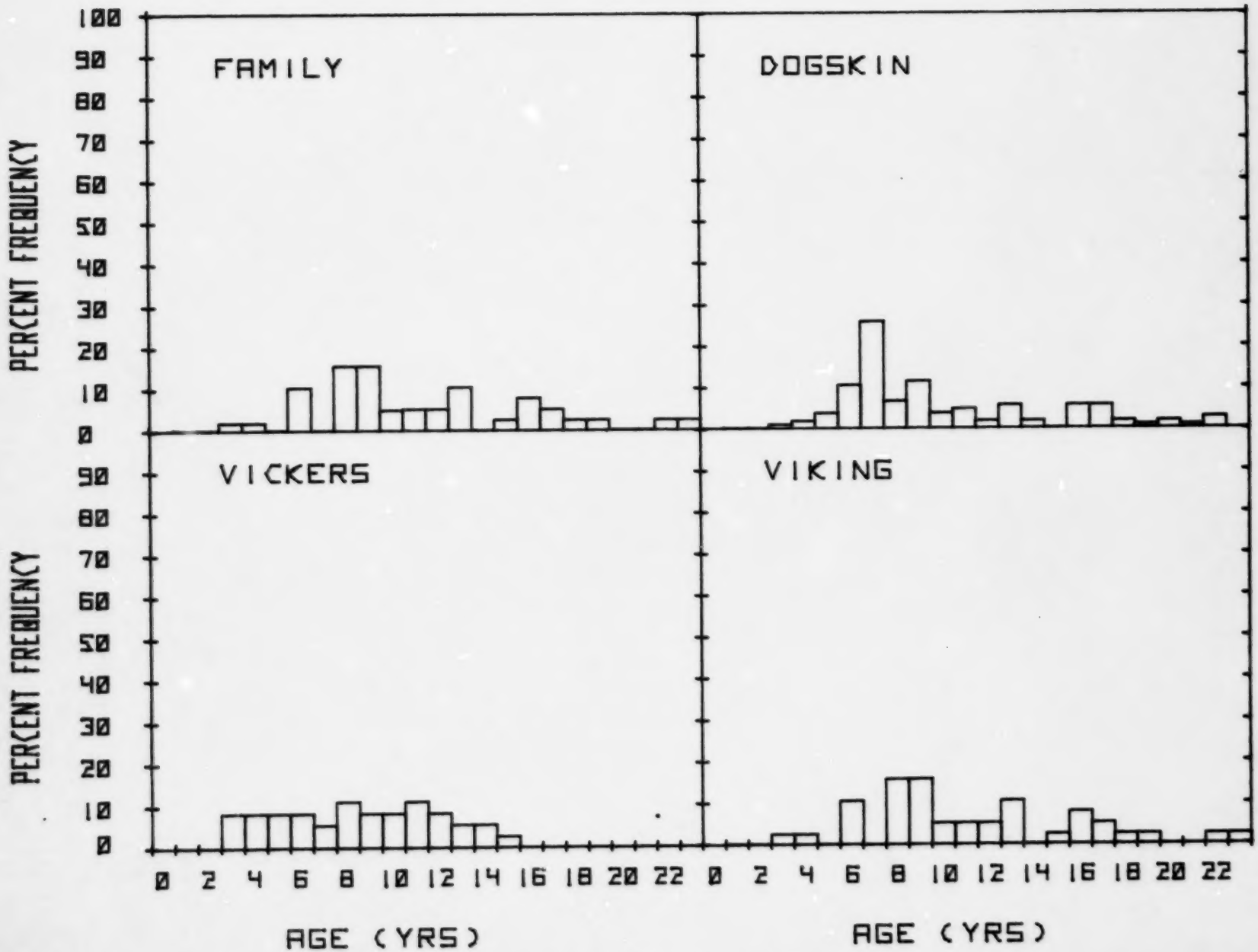


Fig. 16. Age – frequency distribution of walleye from Dogskin, Family, Viking, Vickers lakes, 1978.

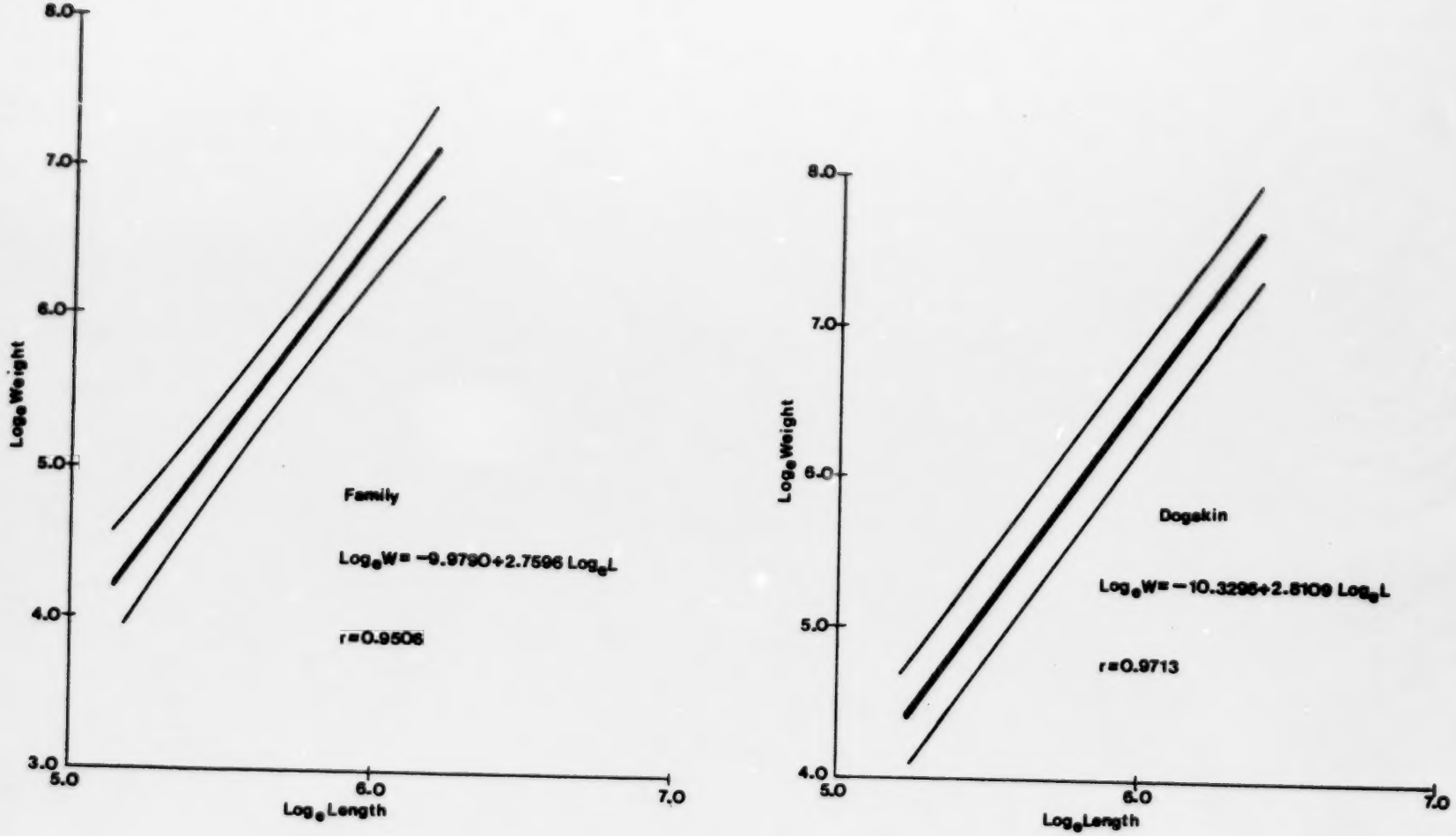
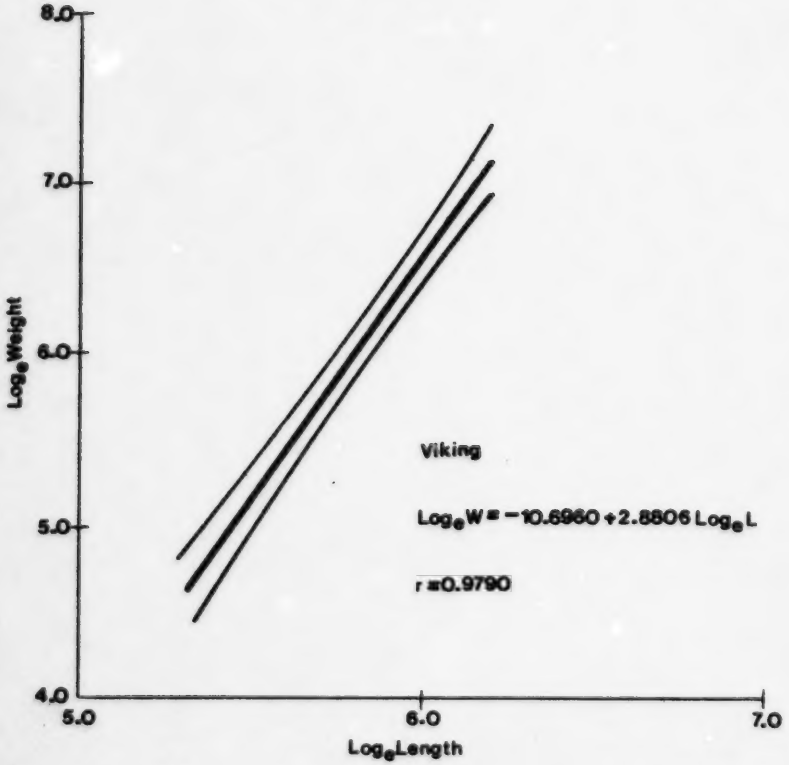


Fig. 17. Length–weight relationship and confidence belt of walleye from Dogskin and Family lakes, 1978.



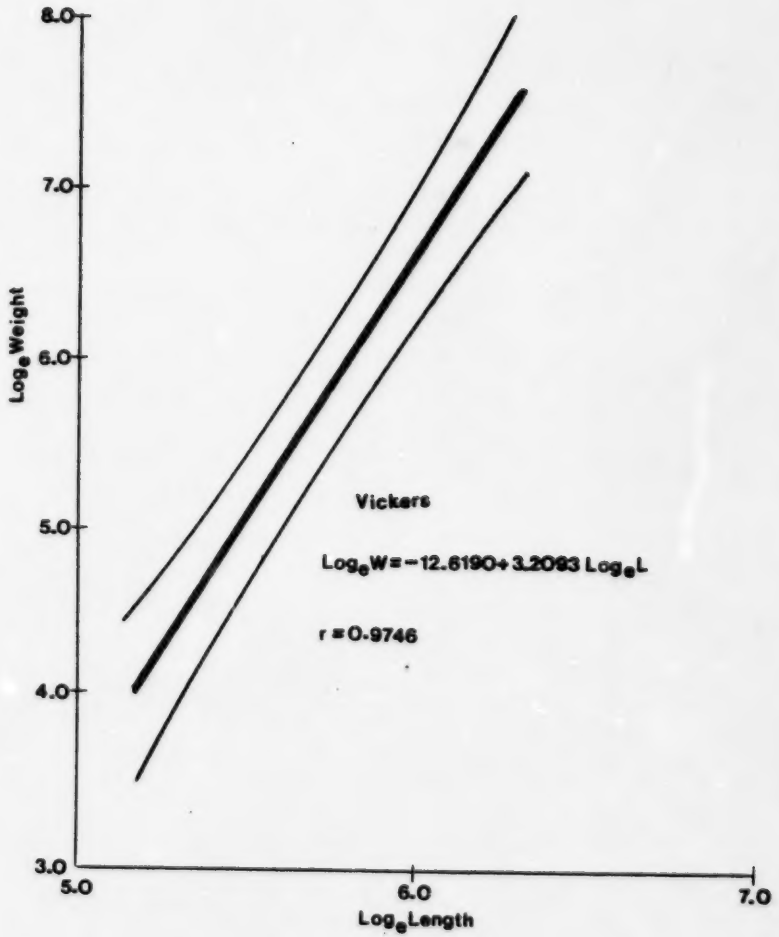


Fig. 18. Length–weight relationship and confidence belt of walleye from Viking and Vickers lakes, 1978.

Vickers walleye

$$\text{Log}_e W = -12.6190 + 3.2093 \text{ Log}_e L$$

$$r = 0.9746, P<0.05$$

The condition factors for walleye sampled from each lake are presented in Table 11.

The male : female ratio of walleye from Dogskin Lake was 1:1.5. Forty-five percent of the males and 62.9 percent of the females were mature. The mean weighted age of onset of sexual maturity was 7.6. The mean age of the sample was 9.1 years.

The male : female ratio of walleye from Family Lake was 1:2.9. Sixty-eight percent of the males and 67.6 percent of the females were mature. The mean weighted age of the onset of sexual maturity was 7.2 years. The mean age of the sample was 9.3 years.

The male : female ratio of walleye from Viking Lake was 1:2.4. This sample was composed of 63.6 percent mature males and 74.1 percent mature females. The mean weighted age of the onset of sexual maturity was 7.9 years and the mean age of the standard gang catch was 10.3 years.

Table 9. Condition factors of walleye sampled from the lakes surveyed. (sample size in parenthesis)

Age	Lake			
	Dogskin June 24 - 26	Family June 30 - July 6	Viking July 9 - 10	Vickers July 12 - 13
2	1.20 (1)		1.14 (1)	1.23 (3)
3	1.07 (2)	1.62 (2)	1.04 (1)	0.76 (3)
4	1.14 (4)	1.13 (3)	- -	1.08 (3)
5	1.09 (11)	1.18 (4)	1.12 (4)	1.19 (3)
6	1.06 (27)	1.19 (14)	- -	1.15 (2)
7	1.09 (7)	1.10 (8)	1.11 (6)	1.22 (4)
8	1.09 (12)	1.08 (29)	1.12 (6)	1.13 (3)
9	1.10 (4)	1.10 (8)	1.22 (2)	1.07 (3)
10	1.09 (5)	1.11 (2)	1.03 (2)	1.16 (4)
11	1.06 (2)	1.20 (1)	1.08 (2)	1.26 (3)
12	0.98 (6)	1.16 (8)	1.14 (4)	1.06 (2)
13	1.12 (2)	1.18 (4)	- -	1.09 (2)
14	- -	1.05 (5)	1.15 (1)	2.12 (1)
15	1.02 (6)	1.11 (5)	1.08 (3)	- -
16	1.04 (6)	1.14 (2)	1.07 (2)	- -
17	1.14 (2)	1.10 (2)	1.14 (1)	- -
18	1.03 (1)	- -	1.40 (1)	- -
19	1.21 (2)	- -	- -	- -
20	1.26 (1)	- -	- -	- -
21	1.03 (3)	- -	1.00 (1)	- -
22	- -	1.09 (1)	- -	- -
23	- -	1.16 (1)	1.23 (1)	- -
Avg.	1.08 (104)	1.13 (99)	1.12 (38)	1.15 (36)

The male : female ratio of walleye from Vickers Lake was 1:4.1. It was found that 57.1 percent of the males and 62.1 percent of the females were mature. The mean weighted age of the onset of sexual maturity was 6.5 years and the mean age of the sample was 7.5 years.

Northern pike age and growth

The growth of the northern pike sampled from each lake in terms of length and weight, is illustrated in Figs. 19 and 20 respectively. The interval about the curves is plus and minus one standard error (± 1SE).

The age-frequency distribution of the northern pike sampled is illustrated in Fig. 21. The age groups represented were between 2 and 13 years with the majority from age groups 5 and 6.

The length-weight relationships of the northern pike from the lakes surveyed are illustrated in Fig. 22. The equations for the linear regressions are:

Dogskin northern pike

$$\text{Log}_e W = -9.3952 + 2.6079 \text{ Log}_e L$$

$$r = 0.8875, P<0.05$$

Family northern pike

$$\text{Log}_e W = -9.6293 + 2.6442 \text{ Log}_e L$$

$$r = 0.8728, P<0.05$$

Viking northern pike

$$\text{Log}_e W = -11.9521 + 3.0135 \text{ Log}_e L$$

$$r = 0.9938, P<0.05$$

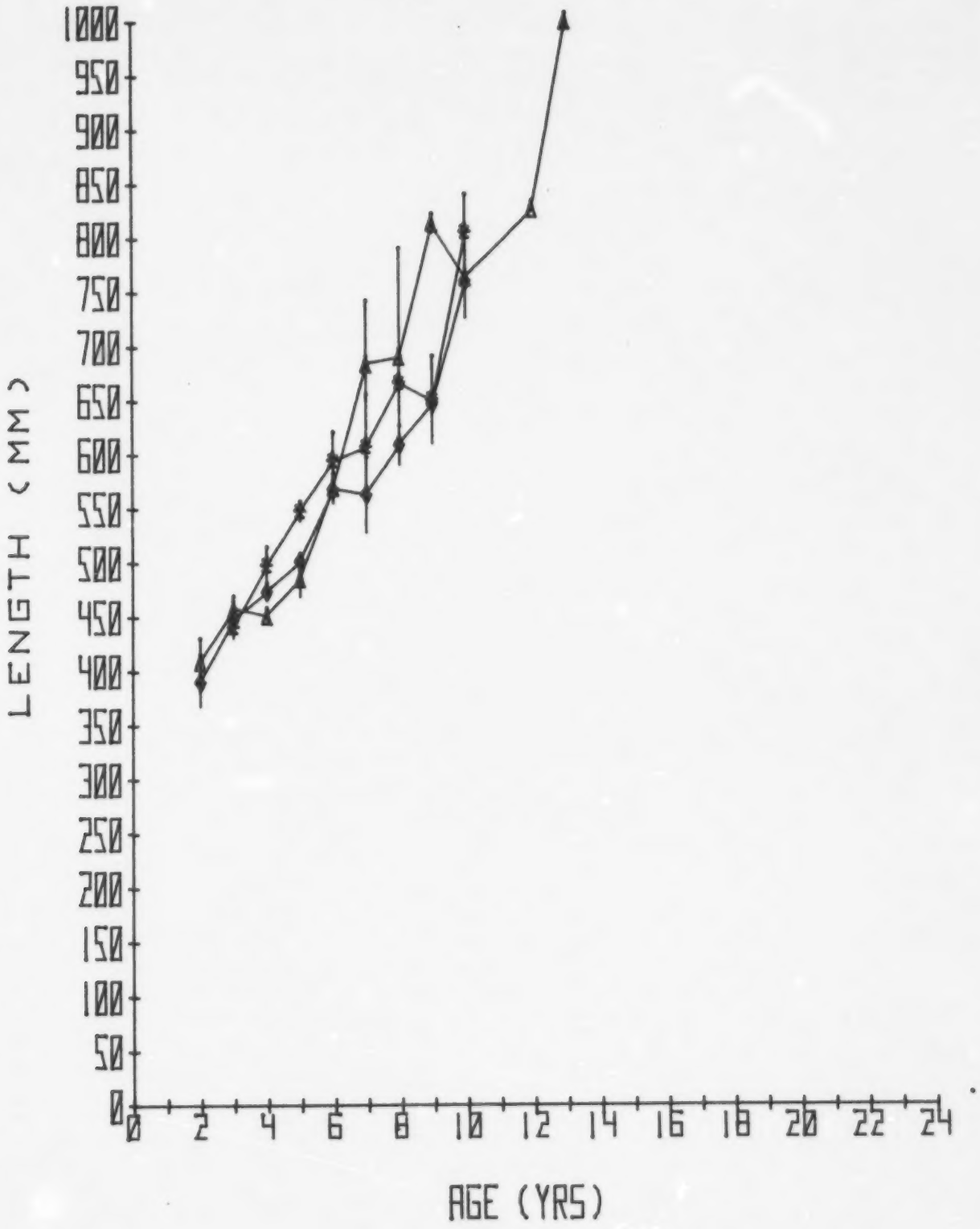


Fig. 19. Length–age relationship and standard error of means of northern pike from the lakes surveyed. (Dogskin ●, Family ◆, Viking ■).

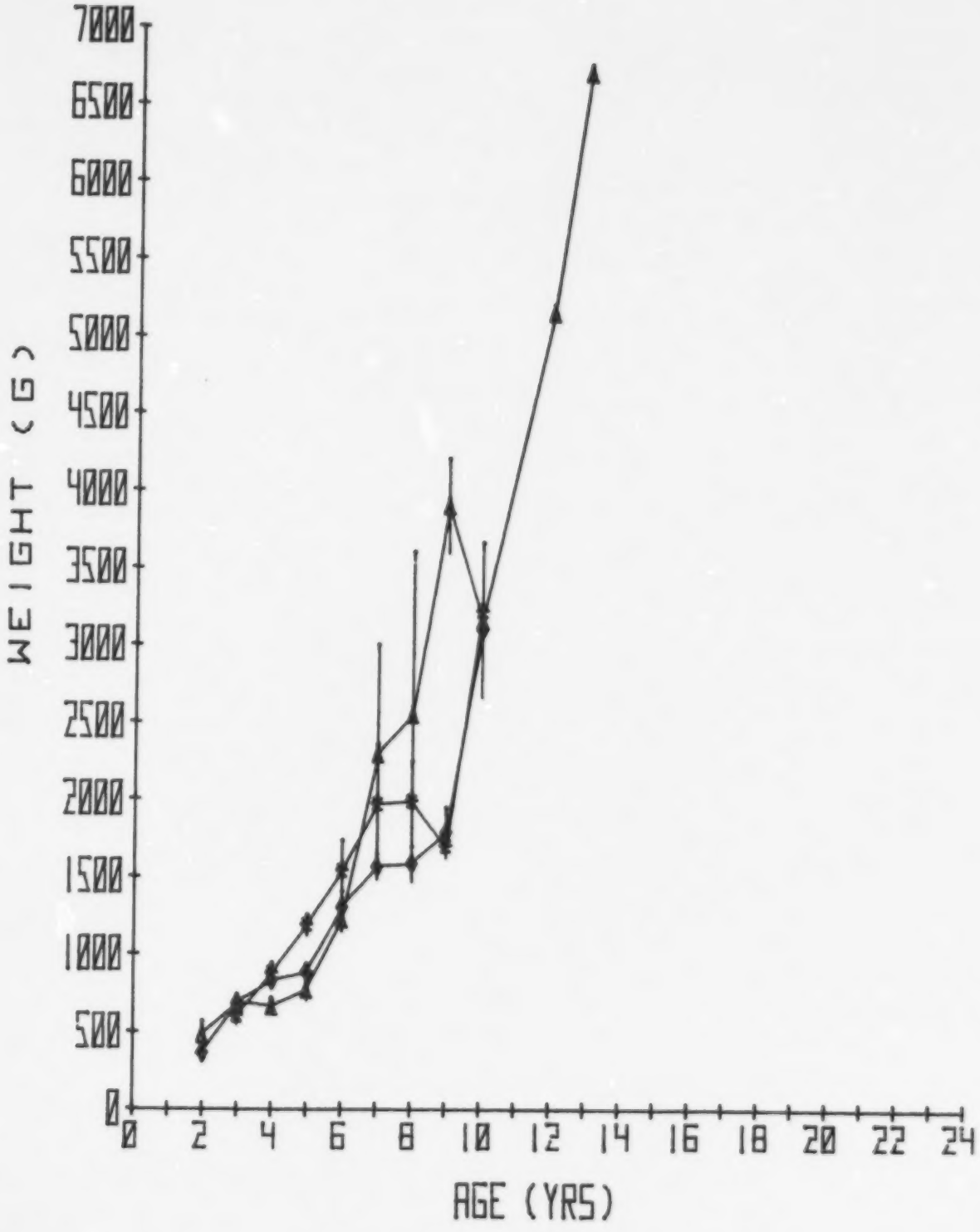


Fig. 20. Weight – age relationship and standard error of means of northern pike from the lakes surveyed (Dogskin ●, Family ◆, Viking ▲, Vickers ■).

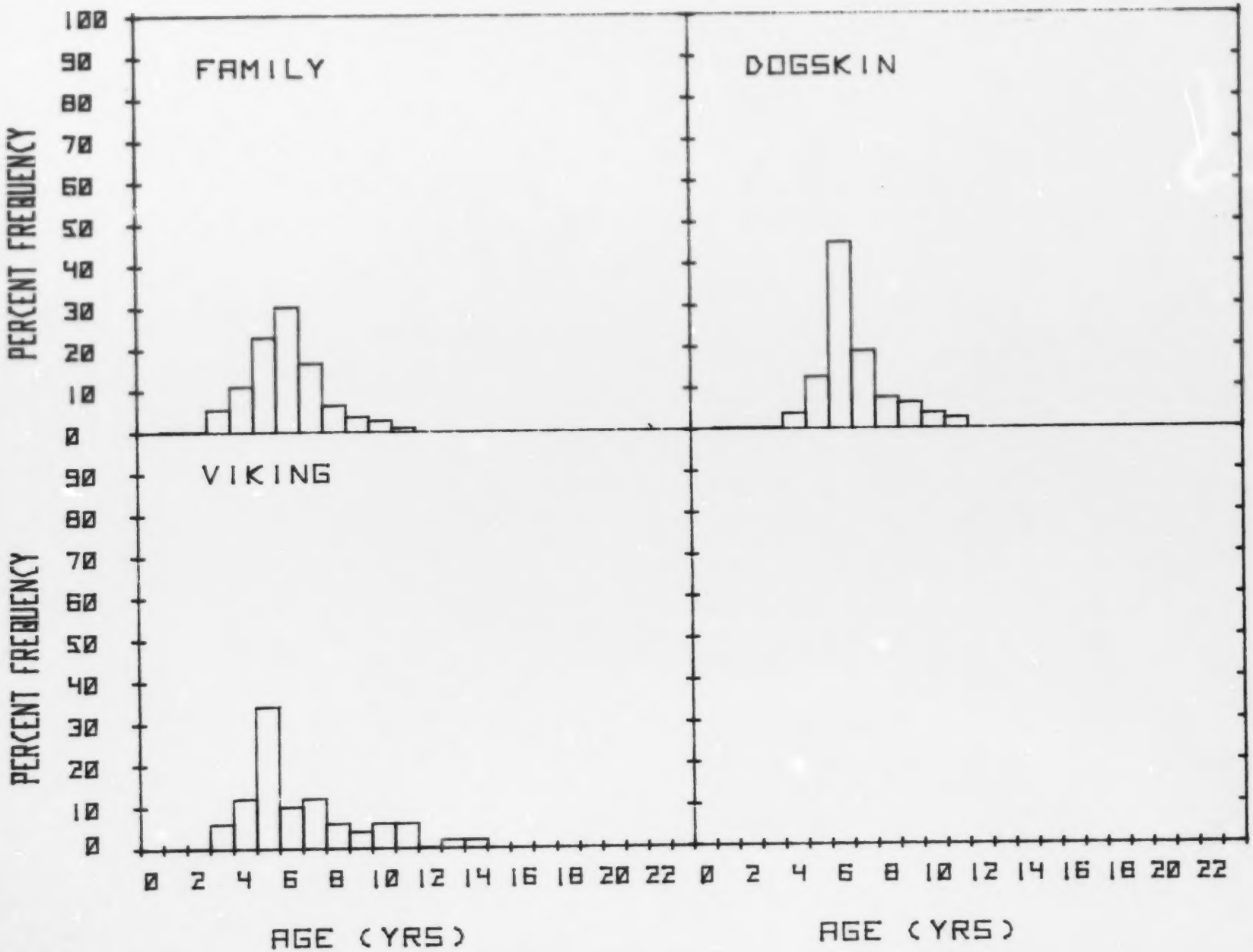
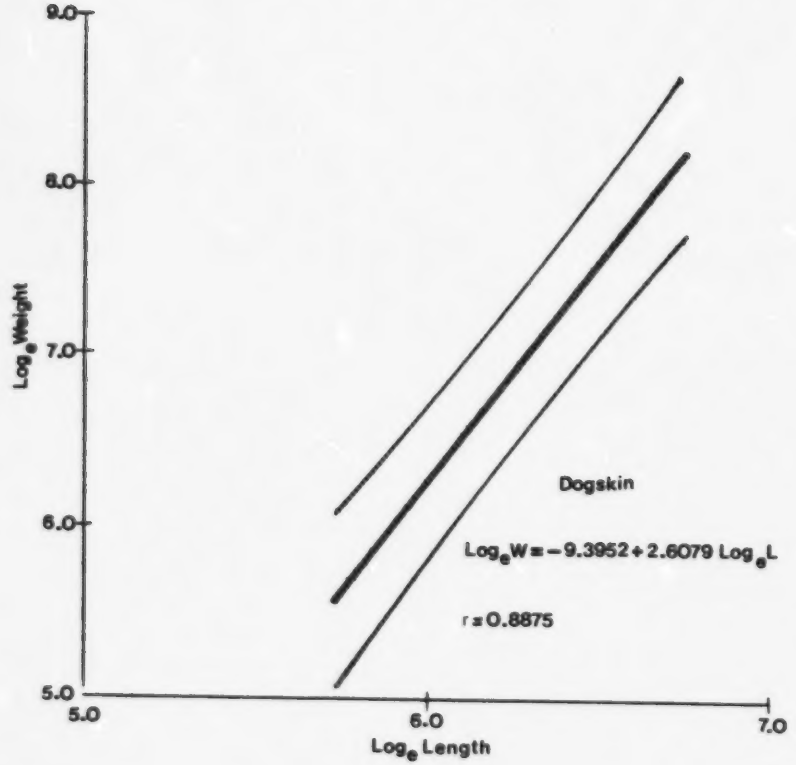


Fig. 21. Age frequency distribution of northern pike from Family, Dogskin and Viking lakes, 1978.



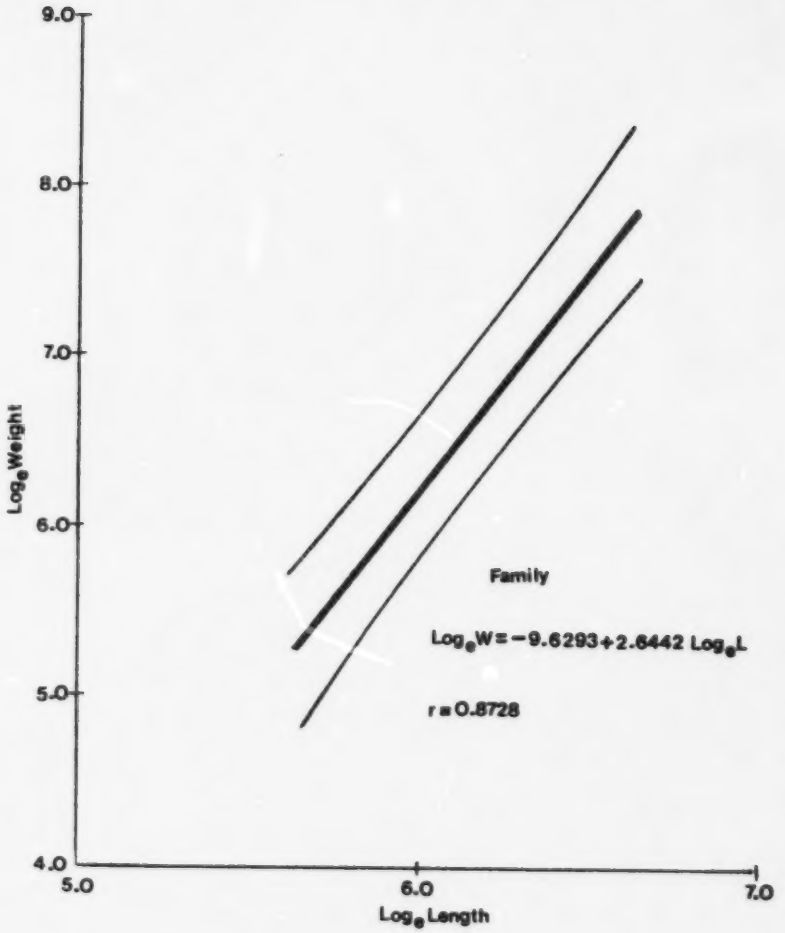


Fig. 22. Length–weight relationship and confidence belt of northern pike from Dogskin, Family, and Viking lakes, 1978.

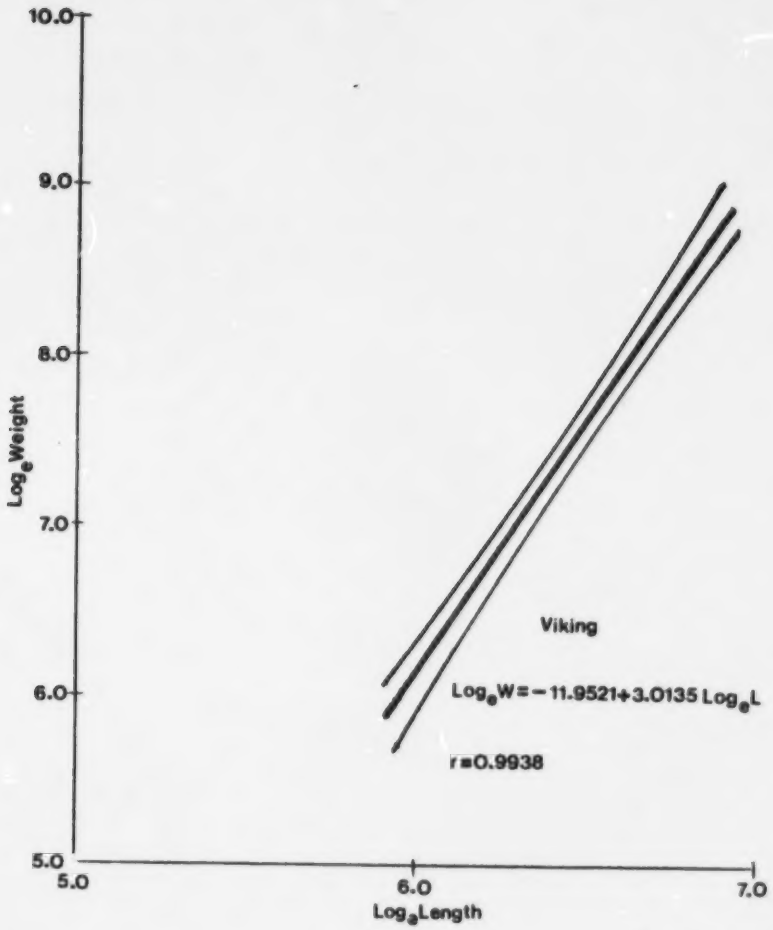


Fig. 22 continued.

There were insufficient numbers of northern pike captured in Vickers Lake to warrant statistical analysis.

The condition factors calculated from the length-weight data, for the lakes surveyed, are summarized in Table 10.

The maturity data for northern pike samples from the gill nets in Dogskin Lake showed 93.7 percent of the males and 100.0 percent of the females were mature. The male to female sex ratio was 1:1.4, the mean age of onset of sexual maturity was 3.1 years and the mean age of the northern pike sampled was 5.6 years.

Family Lake northern pike had a male : female sex ratio of 1: 2.9. The percentage of mature males was 81.5, and the percentage of mature females was 84.8, the mean age of onset of sexual maturity was 3.3 years and the mean age of the northern pike sampled was 4.9 years.

In Viking Lake the male : female sex ratio of northern pike was 1: 1.2. It was found that 81.8 percent of the males and 78.6 percent of the females were mature, the mean age of onset of sexual maturity was 3.5 years and the mean age of the catch was 5.4 years.

Production potential

The MEI (Ryder, 1965) has been applied to the morphometric and edaphic properties of the lakes to provide an estimate of the maximum sustained yield (MSY) in kg/ha/yr (Table 11). The mean depth of Viking and Vickers lakes is less than the minimum for accurate application of the equation Ryder et al (1974). The results for these lakes should therefore be interpreted with caution.

Table 10. Condition factors of northern pike from the lakes surveyed. (Sample size in parentheses).

Age	Lake		
	Dogskin June 24 - 26	Family June 30 - July 6	Viking July 9 - 10
2	--	0.65 (5)	0.69 (3)
3	0.70 (3)	0.76 (12)	0.72 (6)
4	0.72 (10)	0.79 (25)	0.72 (17)
5	0.68 (35)	0.71 (32)	0.67 (5)
6	0.67 (15)	0.69 (18)	0.66 (6)
7	0.71 (5)	0.80 (6)	0.67 (3)
8	0.66 (5)	0.71 (4)	0.73 (2)
9	0.63 (3)	0.66 (3)	0.72 (3)
10	0.61 (2)	0.71 (1)	0.70 (3)
11	--	--	--
12	-	-	0.91 (1)
13	-	-	0.67 (1)
Avg.	0.68 (78)	0.73 (106)	0.70 (50)

Table 11. MEI and estimated production potential (MSY) for the lakes surveyed.

Lake	Mean depth (m)	TDS (mg/l)	MEI	Production potential (kg/ha/yr)
Dogskin	5.04	56.00	11.09	4.33
Family	4.23	78.00	18.46	5.51
Viking	1.93	67.00	35.26	7.50
Vickers	2.21	45.50	20.59	5.81

The morphoedaphic index for all the lakes falls in the eutrophic range (Adams and Olver, 1977).

DISCUSSION

Inflow and outflow

Tributary streams and rivers exert a major influence on the community dynamics of the fisheries resource of a lake. They provide spawning, nursery and feeding areas for walleye, northern pike, suckers and various minnow species. Absence of suitable tributaries with spawning areas for these species restricts their distribution and abundance. The walleye and northern pike in such instances are forced to seek out suitable habitat within the lake itself for spawning and feeding activities. Walleye characteristically spawn in the gravel bottom areas of tributary streams. In the absence of stream spawning areas they will also spawn in the boulder to coarse gravel shoals of lakes. Northern pike spawn on heavily vegetated flood plains of rivers and tributary streams and in the weedy marshes and shallow bays of lakes.

Observations of tributaries and littoral habitat of Dogskin, Family, Viking and Vickers lakes indicate no shortage of suitable spawning habitat exists for the sport species. The small sample of northern pike from Vickers Lake was probably due to the intensity of gill netting.

Physical and chemical parameters

Temperature and dissolved oxygen are major limiting factors to the distribution and abundance of fish. Each species of fish has a preferred temperature range for optimum growth. At the upper and lower limits of their preferred temperature range increased metabolic stress reduces growth rates. The short growing season of this area (June to September) also restricts growth. The temperature profiles recorded for the lakes were very close to the lower limit of 20°C, the physiological optimum described by Hokanson (1977) for temperate mesotherm fishes. It would appear, there-

fore that the short growing season of this area would have a greater effect on the growth of the fish than summer extremes of water temperature.

Analysis of the water chemistry data from the lakes showed little difference among the lakes (Table 3). The ionic composition of the water in these lakes is similar to that described by Armstrong and Schindler (1971) for dilute Canadian Shield Lakes.

Fisheries resource

The coefficient of condition or condition factor describes the length-weight relationship or body condition of the fish. This relationship varies according to gonadal condition, fullness of the gut, the amount of fat reserve and the degree of muscular development. Average condition factors for walleye from these lakes (Table 9) were similar to those of walleye from Obukowin and Aikens lakes (Hagenson and O'Connor, 1979) indicating the quality of the environment of these Precambrian Shield lakes for walleye is similar.

Condition factors of the northern pike from these lakes (Table 10) were also very similar to the values obtained for northern pike from Obukowin and Aikens lakes (Hagenson and O'Connor, 1979). Although these figures are slightly less than condition factors recorded from pike in Whiteshell lakes, (Hagenson and O'Connor, 1978a), this can probably be attributed to the fact that samples were taken from the Whiteshell near the end of the summer growing season.

A comparison of growth of walleye from the lakes surveyed to Obukowin and Aikens lakes is presented in Table 12. The comparison of growth is valid as all ages were determined from otoliths. The growth of walleye from the lakes surveyed was close to that of Aikens Lake. Since Dogskin, Family, Viking, Vickers and Aikens lakes are rather intensively fished while Obukowin Lake is virtually unexploited it would appear that

Table 12. Comparison of growth of walleye in Precambrian Shield lakes.

	Fork length in mm at age																									
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Dogskin	—	192	235	272	304	331	370	380	371	415	446	489	475	—	533	512	562	390	510	380	456	—	—	—	—	—	—
Family	—	—	200	273	313	332	354	387	386	398	412	426	398	419	440	401	406	—	—	—	—	420	405	—	—	—	—
Viking	—	206	292	—	332	—	372	379	385	431	405	438	—	390	418	425	472	385	—	—	440	—	412	—	—	—	—
Vickers	—	185	214	255	279	343	369	401	424	420	440	442	503	355	—	—	—	—	—	—	—	—	—	—	—	—	—
Obukowin[1]	—	—	234	246	344	341	342	354	356	362	354	363	361	348	374	369	366	366	370	—	—	—	—	—	—	—	—
Aikens[1]	—	—	—	270	344	349	409	441	452	—	462	410	—	480	—	—	—	—	—	—	—	—	—	—	490	—	635

[1] Hagenson and O'Connor, 1979.

sufficient pressure is being exerted in the intensively fished lakes to effect a density dependent compensatory factor of increased growth rate. It has been documented by Spangler et al (1977) that the most conspicuous response of percid communities to exploitation are changes in variability of recruitment, increased growth rate and reduction in the ages of first spawning.

The calculated Z values for walleye from the study lakes were around 7 - 8 years for each lake. There is a definite decline in the growth rate after this age. (Fig. 14). This conforms to the findings of Power (1978) who stated the growth of Arctic fish populations is relatively rapid until first maturity when it becomes slow through a life span that may exceed 50 years and mortality declines rapidly through early life and stabilizes at a very low level through much of the life span. The age-frequency distribution for walleye (Fig. 16) from the study lakes conforms to this hypothesis.

Kelso and Ward (1977) found a stability of biomass in unexploited percid communities. Adams and Olver (1977) showed the ratio of percid yield to total yield was independent of lake area and productivity which suggested a relatively stable equilibrium in a percid community under exploitation. Analysis of commercial catches from northwestern Ontario lakes showed that approximately one-third of total yield (by weight) was percids. The average percid yield (by weight) of the test nets in the study lakes, 35.6 percent of the total yield, was close to walleye yields in northwestern Ontario Shield lakes. There is, however, a marked difference in relative abundance of percids in the four lakes. Perch were the dominant percid, by number, in Viking and Vickers where walleye were less than half as abundant in the fish community as in Dogskin and Family. These differences may possibly be explained by the limited amount of deep water for negatively phototrophic walleye in Viking and Vickers.

This limitation of suitable habitat for walleye in these two lakes would also be of some benefit for diurnally active perch, an important prey species of walleye.

The percid yield of the commercial harvest of Family Lake (Table 16) far exceeds the one-third by weight average described by Adams and Olver (1977). This is probably due to the higher market value for walleye over the other species. The other species were probably retained for domestic use. The production figures reglect only the fish sold to the Freshwater Fish Marketing Corporation.

A comparison of growth of northern pike from the lakes surveyed to Obukowin and Aikens lakes is presented in Table 13. Lhe range of values for any given age group is quite large, indicating a great deal of variation in growth rate from lake to lake. The age of attainment of sexual maturity for Dogskin, Family and Viking northern pike agrees with what has been reported for other areas (Scott and Crossman 1973 and Franklin and Smith 1963). The attainment of sexual maturity at an early age due to fishing pressure, should ensure a significant population of northern pike in the lakes.

An estimate of the optimum sustained angling yield (OSY) for the study lakes was determined from a linear equation of MEI versus angling yield based on morphoedaphic and creel census data collected from Nutimik, Caddy, White, Betula, Eleanor, Falcon, Brereton, Jessica and Lone Island lakes in the Whiteshell (Fig. 23). The derived metric equation $Y = 0.492\ X^{0.673}$ was applied to the morphoedaphic data from the study lakes and the OSY for moderate quality fisheries were calculated (Table 14).

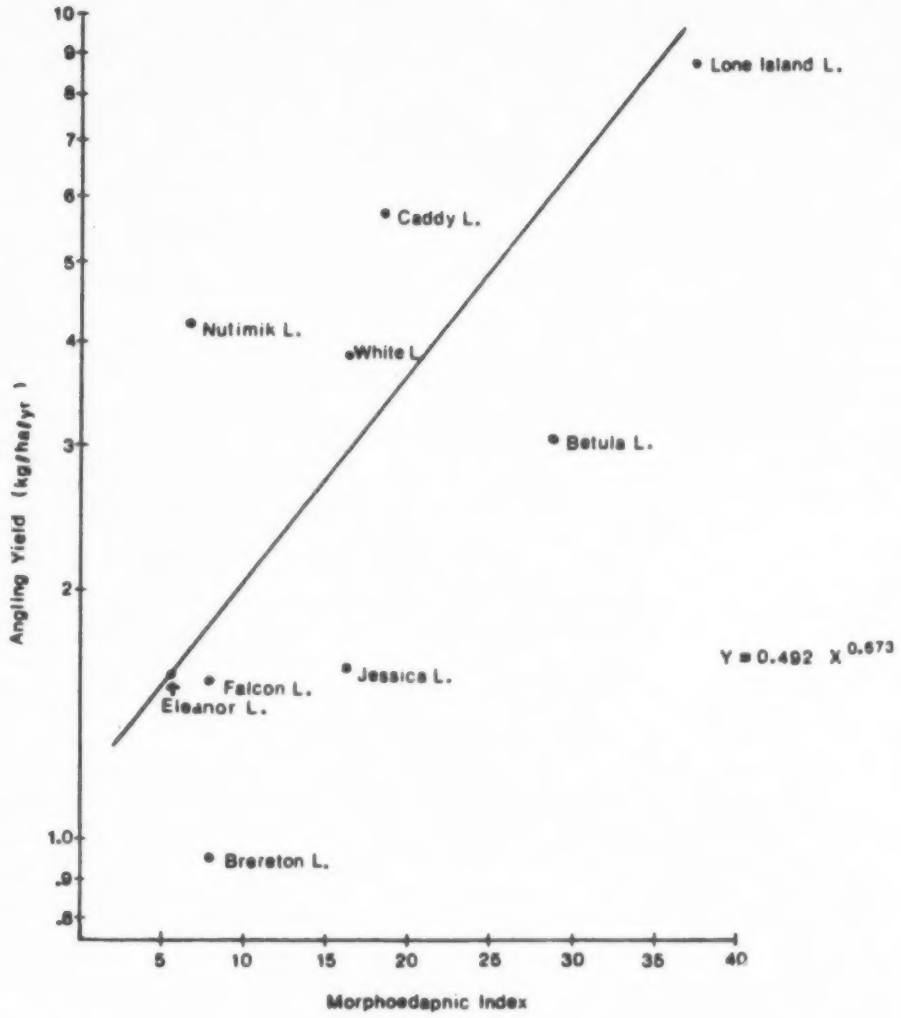


Fig.23. Angling yield related to the morphoedaphic index for a relatively homogenous group of Precambrian lakes in the Whiteshell Provincial Park.

Table 13. Comparison of growth of northern pike in Precambrian Shield lakes.

Lake	Fork length in mm at age												
	1	2	3	4	5	6	7	8	9	10	11	12	13
Dogskin	-	-	440	497	549	594	636	665	650	805	-	-	-
Family	-	383	448	473	501	567	590	608	648	760	-	-	-
Viking	-	408	457	451	485	569	683	690	813	763	-	826	1000
Obukowin[1]	-	375	399	436	478	628	730	610	-	-	-	-	-
Aikens[1]	-	-	490	589	597	611	-	778	-	-	-	-	-

[1]Hagenson and O'Connor, 1979.

Table 14. Estimated OSY for the study lakes based on moderate quality angling.

Lake	MEI	Estimate OSY (kg/ha/yr)
Dogskin	11.09	2.48
Family	18.46	3.50
Viking	35.26	5.41
Vickers	20.59	3.77

The preceding calculations of OSY are based on the moderate quality sport fisheries which exist on developed Whiteshell lakes. A significant portion of recreational fishermen are not satisfied with the fishing opportunities offered by these lakes and prefer high quality angling opportunities in a remote wilderness setting of the type that can be found at Dogskin, Family, Viking and Vickers lakes.

Angling quality, total domestic, sport and commercial harvest and MSY calculations from Bolton and Gods lakes were used to determine that no more than 15 percent of the MSY should be harvested to ensure a sustained high quality sport fishery (Hagenson and O'Connor, 1978b). The estimated harvest of the study lakes to maintain high quality angling opportunities is given in Table 15.

Table 15. OSY for the study lakes based on sustained high quality angling.

Lake	MSY (kg/ha/yr)	Maximum Annual Angler Harvest (15% MSY)
Dogskin	4.33	0.65
Family	5.51	0.83
Viking	7.50	1.12
Vickers	5.81	0.87

An examination of the Manitoba Master Angler Award records from 1974 to 1978 shows that Dogskin produced 11 northern pike and 9 walleye, Family produced 2 northern pike and 5 walleye, Viking produced 7 northern pike and Vickers produced 2 northern pike and 1 walleye. The minimum qualifying weight is 3.6 kg for walleye and 9.0 kg for northern pike. It is apparent that the pike and walleye populations of the study lakes have some trophy potential.

Management Implications

Pike and walleye stocks of Dogskin Lake appear to offer high quality angling opportunities with some trophy potential for guests of the lodge. The present capacity of the lodge is 40 beds. It appears the angler harvest from this guest capacity is not having an adverse effect on the walleye and northern pike populations of the lake. However, the relatively low productivity of the lake may prevent existing fish stocks from maintaining high quality angling opportunities if the angler harvest was increased. It would be in the best interests of the lodge to maintain the present capacity of the facility so that the high quality angling opportunities remain as an attraction to potential lodge guests. If the capacity of the lodge was increased to a point where the fish stocks of Dogskin Lake could no longer maintain high quality angling opportunities the marketability of the operation would be reduced.

Family Lake is the largest of the study lakes and the most intensively fished. The community of Little Grand Rapids and Family Lake Lodge are located on the lake. There is a commercial fishery for the summer and winter seasons with an annual quota of 31,750 kg for the two quota species, walleye and whitefish. The production of this fishery in recent years is summarized in Table 16.

Table 16. Commercial catches (kg) from Family Lake 1972-1978 and other details of the commercial harvest.

	Summer 1972	Summer 1973	Summer 1976	Summer 1977	Summer 1978
Walleye	890	3010	4166	7694	6109
Lake whitefish	499	551	163	271	34
Northern pike	109	1365	2896	957	180
Total	1498	4926	7225	8922	6323
Licences	11	6	8	10	13
kg/ha	0.14	0.45	0.66	0.81	0.58
% of quota	4.7	15.5	22.8	28.1	19.9
% of MSY	2.5	8.1	11.9	14.7	10.4

The 31,750 kg quota for Family Lake is 52.4 percent of the estimated MSY of the lake (60,533 kg). The commercial harvest of recent years has averaged 9.5 percent of the MSY.

The domestic harvest of remote communities in Manitoba has been estimated to be 22.0 kg per person (Carl Wall personal communication). If this estimate is applied to Family Lake the domestic harvest would be approximately 13,684 kg (22.6 percent of the MSY).

Family Lake Lodge is presently licenced for only 6 beds although it is capable of holding 20 beds when fully operational. A creel census never has been conducted, however, and no estimate of sport fish harvest is available.

The combined harvest of Family Lake by sport, commercial and domestic users is exerting significant pressure on the fish stocks of the lake, particularly the walleye. However, the data gathered during this study indicates the present harvest has not severely effected those stocks. The age-frequency distribution for walleye (Fig. 16) shows a good representation of older age groups. The gill net summary (Table 6) indicates that a significant population of sport species inhabit Family Lake.

When Family Lake Lodge is fully operational again (20 beds) the combined sport, commercial and domestic harvest may approach the MSY harvest estimate of 5.51 kg/ha. Therefore, considering domestic use and the quota of fishes needed for allocation to support a 20 bed lodge and the average commercial harvest of recent years the commercial quota should be reduced to no more than 30 percent of the MSY (18,160 kg).

Viking and Vickers lakes are small interconnected lakes in an area of the Pigeon River System of relatively flat relief. The shallow depth and small size of these lakes and the integral association of their stocks with upstream and downstream populations limit the opportunities for stock enhancement through selective stocking or regulatory programs.

Recommendations

1. The capacity of Dogskin Lake Lodge not be increased and no other lodges or outcamps be allowed on the lake.
2. The present regulatory measures on Family Lake be reviewed and the fisheries resource allocated so as not to exceed the estimated maximum sustained yield of the lake.
3. Viking and Vickers lakes be left as remote wilderness lakes suitable for day use or outcamp use.

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Appendix 1. Benthic organisms from the lakes surveyed.

Benthic Organisms	Dogskin	Family	Viking	Vickers
Diptera				
Tendipes	*	*	NO DATA	
Pentaneura	*	*		
Metriocnemus	*	*		
Hydrobaenus		*		
Palpomyia		*		
Chaoborus	*	*		
Corynoneura		*		
Procladius	*			
Trichoptera				
Rhyacophila		*		
Helicopsyche		*		
Hesperophylax		*		
Ephemeroptera				
Hexagenia	*	*		
Cladocera				
Daphnia	*	*		
Amphipoda				
Pontoporeia		*		
Megaloptera				
Sialis		*		
Pelecypoda				
Sphaeriidae		*		
Gastropoda		*		
Nematoda		*		
Oligochaeta				
Aedosoma		*		
Nais		*		

Appendix 2. Plankton from the lakes surveyed.

	Dogskin	Family	Viking	Vickers
Zooplankton				
Copepoda				
Cyclops	*	*	NO DATA	
Diaptomus	*	*		
Nauplii	*	*		
Harpacticidae		*		
Epischura	*			
Cladocera				
Daphnia	*	*		
Diaphanosoma	*	*		
Chydorus	*	*		
Bosmina	*			
Sida	*			
Leptodora		*		
Rotatoria				
Kellicottia	*	*		
Asplanchna	*	*		
Trichocerca	*	*		
Polyarthra	*	*		
Keratella	*			
Phytoplankton				
Anabaena		*		
Lyngyba		*		
Ceratium	*	*		
Gloetrichia	*	*		
Microcystis	*			
Surirella	*			
Pediastrum	*			
Fragilaria	*			
Milosira	*			
Tabellaria	*			
Asterionella	*			